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NUCLEAR CRITICALITY SAFETY EVALUATION FOR THE HANDLING AND STAGING OF PLUTONIUM PROCESS AND UTILITY PIPING FROM THE PRODUCT PURIFICATION CELL

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SYSTEM NUMBER

A. Sweet *Signature and Date on File in Records & Configuration/Document Control*

ORIGINATOR

K. R. Schneider *Signature and Date on File in Records & Configuration/Document Control*

COGNIZANT MANAGER

J. C. Wolniewicz *Signature and Date on File in Records & Configuration/Document Control*

TECHNICAL SPECIALIST

J. C. Gerber *Signature and Date on File in Records & Configuration/Document Control*

RADIATION AND SAFETY COMMITTEE CHAIRMAN (for NCSE)

ER NUMBER #25541

ECN NUMBERS ____________

WVNSCO
West Valley Nuclear Services Company

10282 Rock Springs Road
West Valley, New York USA 14171-9799

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Nuclear Criticality Safety Evaluation for the Handling and Staging of Plutonium Process and Utility Piping from the Product Purification Cell

1.0 INTRODUCTION

This nuclear criticality safety evaluation (NCSE) documents the criticality and contingency analyses that have been performed to support the safe handling and staging of plutonium process and utility piping that is located in the Product Purification Cell (PPC) of the Main Plant at the West Valley Demonstration Project (WVDP).

2.0 DESCRIPTION

The PPC is located at the south end of the Main Plant immediately next to and east of Extraction Cell 3 at a plant elevation of 100 ft. A stainless steel liner covers the floor of the cell and extends 46 cm (18 in) up the walls; the remainder of the cell is carboline-coated concrete.

The south portion of the PPC contains evaporators, ion-exchange columns, vessels, and piping that were originally used for the final purification and concentration of uranium nitrate and plutonium nitrate product streams. The main process influents originated in Extraction Cell 3: Tank 5D-1 for the plutonium (Pu) product stream and Column 4C-12A for the uranium (U) product stream. After processing in the PPC, the plutonium product stream was transferred to Product Packaging and Shipping, and the uranium product stream was transferred to the Uranium Product Cell. Other process streams were either routed for recovery/rework or to waste disposal.

The portion of the PPC located north of an in-cell concrete divider wall was decontaminated from 1984 to 1986. The current project entails the removal of plutonium process and utility piping from the south portion of the cell. This piping may contain significant quantities of long-lived radionuclides. Removal will be accomplished manually by personnel physically entering the cell.

2.1 Characteristics of PPC Piping and Equipment

A limited number of historical radiation measurements have been reported for the PPC (Riethmiller 1981). In 1972, readings of up to 300 mR/hr were reported; readings of less than 100 mR/hr were reported in 1973. The measurement locations are unknown. Contamination levels both internal and external to piping and equipment are also unknown. According to WVNSCO Memo FF:2002:0008, *Unreviewed Safety Question Determination - Product Purification Cell Clean-Up*, “The current residual inventory estimates have no direct analytical or measurement basis, but were derived from the limited radiation measurements and assumptions on the radiological distribution. In one case, a spent fuel radiological distribution was used, in another, a distribution derived from analysis of samples from the northern portion of the cell [was used]. Combined with the possibility of material hold-up in vessels...the existing estimates are expected to be neither accurate nor bounding.”

Piping in the plutonium process system is constructed of 304L stainless steel and has nominal dimensions ranging from 1/8", which was typically used for instrumentation, to 1-1/2", which was used primarily for tank and vessel ventilation. Process solution lines were typically smaller in diameter. In terms of overall length of piping, approximately half of the plutonium process piping in the cell was nominal 1/2" schedule 80 piping, while approximately 30 percent was nominal 3/4" schedule 80 pipe. Based on historical records it is believed that these lines were flushed for decontamination and plutonium recovery and it is not expected that significant quantities of plutonium remain in system piping. Engineering review of isometric drawings of cell piping indicates that there is approximately 2,000 linear feet of piping in the plutonium product and utility systems.

2.2 Summary of Decontamination Activities

Characterization information will be collected on the PPC plutonium process and utility piping to support packaging in waste disposal containers. As noted in WVNSCO Memo FF:2002:0008, several different characterization methods will be used due to the breadth of information needed. These methods will be implemented in stages and may include visual investigation, radiological measurement, tell-taling to detect residual liquids, sample collection, and laboratory analysis. Work will proceed from the bottom portion of the cell to the top.

Piping tell-tales will reveal the presence of liquid. If liquid is found, it will be sampled and analyzed. Solid samples will be collected from each type of pipe, from major equipment, and from loose debris. Sampling operations may include removal of encrusted material from inside equipment, cutting coupons using mechanical cutting methods, and/or smear samples. Bulk solids contained within equipment will also be sampled and analyzed if necessary for future safe handling. Piping will be cut using mechanical cutting methods (e.g., band saws or shears) and sectioned as necessary to accommodate packaging into waste containers.

Packaging criteria and waste container selection will be based upon characterization results, the subsequent development of waste profiles, and on waste packaging-related Process Safety Requirements. PPC waste streams will either be packaged within the cell or transferred to a containment tent for placement into containers, then removed from the containment tent and transferred to on-site storage in the Lag Storage Facilities.

Heterogeneous loose debris is also present in the cell and requires removal for safe operations. The debris consists of surface-contaminated materials generated during previous work in the north section of the PPC and possibly some cut piping that has the potential to be internally contaminated.

Following the removal of piping and equipment, an estimate will be made of residual radioactivity on the cell surfaces and remaining support structures. If warranted to meet long-term performance goals, decontamination will be performed to reduce radioactivity levels. Since contamination will have been fixed to the surfaces earlier in the project, decontamination would entail removal of at least the fixative coating(s). Spent decontamination media would be packaged and removed from the cell for eventual disposal or transferred to an on-site treatment facility.

3.0 REQUIREMENTS DOCUMENTATION

There are no requirements that are unique to this evaluation. This NCSE has been developed in accordance with WVDP-162, *WVDP Nuclear Criticality Safety Program Manual*.

4.0 METHODOLOGY

This NCSE considers potential criticality issues associated with the handling and staging of plutonium process and utility piping from the PPC.

4.1 Calculational Method

This NCSE uses published experimental data and analytical methods that have been validated by comparison with experimental data. The calculations that provide the basis for this NCSE were performed using two computer codes: KENO V.a and Monte Carlo n–Particle (MCNP) 4A. An overview of each code is provided in this section.

Criticality calculations for PPC piping were performed using the KENO V.a module in the Standardized Computer Analyses for Licensing Evaluation (SCALE), Version 4.3, to estimate the neutron multiplication factor (k_{eff}). Verification and validation guidance and information related to KENO-V.a are provided in NUREG/CR-6483, *Guide to Verification and Validation of the SCALE-4 Criticality Safety Software*. The SCALE package is validated using published experimental data and a comparison is made between experimental values and calculated values to determine a bias. The experimental data used in the validation demonstrate that the computer code successfully applies to the models used in this evaluation.

The personal computer (PC) version of KENO V.a was run on an IBM Pentium IV, 1.3 GHz system, operating in a Windows 98 environment. Evaluated Nuclear Data File (ENDF) B-IV 27 energy group cross sections were used in all estimates of k_{eff}. A minimum value for k_{eff} (k_{min}) was established such that any KENO V.a calculation of k_{eff} equal to or greater than the minimum was considered critical. The k_{min} includes a bias established by correlating the results of critical benchmark experiments and also includes a margin of subcriticality. Based on an evaluation of the code bias, a subcritical limit of 0.93 was selected for use in this NCSE in assessing the criticality safety of normal operations.

Criticality calculations were also performed using MCNP 4A. MCNP is a general purpose, continuous energy, generalized geometry, time-dependent, coupled neutron-photon-electron Monte Carlo transport code system. MCNP treats an arbitrary three-dimensional configuration of materials in geometric cells bounded by first and second-degree surfaces and some special fourth-degree surfaces. For neutrons, all reactions in a particular cross-section evaluation are accounted for. MCNP is distributed by the Radiation Safety Information Computational Center (RSICC) located in Oak Ridge, Tennessee. Documentation for MCNP 4A is provided in LA-12625, *MCNP - A General Monte Carlo n–Particle Transport Code.*

MCNP uses continuous-energy nuclear and atomic data libraries from sources such as the ENDF system. Pointwise neutron cross section data are used and, for neutrons, all reactions given in a particular cross section evaluation are accounted for. Cross sections (whether continuous or discrete) based on ENDF/B-V evaluations are believed to be the best available to MCNP users at this time. Consequently, the ENDF/B-V cross section library was used for all evaluations referenced in this report.

The personal computer (PC) version of MCNP 4A was run on a Toshiba Pentium III, 333 MHz system, operating in a Windows 95 environment. *MCNP 4A Software Validation Plan and Report for Criticality Calculations* provides documentation of the validation activities that were performed to support the criticality calculations addressed in this NCSE. The bias and bias uncertainty related to the use of MCNP for evaluation of moderated and unmoderated systems containing plutonium are addressed in *MCNP 4A Software Validation Plan and Report for Criticality Calculations*. Through an evaluation of the code bias, a subcritical limit of 0.93 was selected for use in this NCSE in assessing the criticality safety of normal operations.

The criticality safety of PPC operations has been determined through the performance of a number of bounding analyses. These analyses evaluate a spectrum of conditions to envelope a broad range of potential decontamination operations. By design, these analyses range from a set of credible and anticipated conditions representing highly subcritical systems, to incredible configurations representing systems having the maximum reactivity for a given parameter or set of parameters such as geometry, enrichment, or moderation.

The intent of a criticality analysis is to demonstrate, in writing, to the satisfaction of qualified criticality analysts and reviewers, that a criticality concern has been satisfactorily evaluated and addressed through the imposition of appropriate controls as necessary. The analyses provided herein are considered to more than meet such an intent.

Critical Data:

1. LA-10860-MS, Figure 33 gives an infinite cylinder critical diameter of 22 cm for an unreflected cylinder containing $Pu(NO_3)_4$ solution at 200 g Pu/L with 1 N HNO_3 and 3.1% Pu-240 content.

2. LA-10860-MS, Figure 33 gives an infinite cylinder critical diameter of 14 cm for a water-reflected cylinder containing $Pu(NO_3)_4$ solution at 200 g Pu/L with 1 N HNO_3 and 3.1% Pu-240 content.

3. LA-10860-MS, Figure 34 gives an infinite slab thickness of 13 cm for an unreflected slab containing $Pu(NO_3)_4$ solution at 200 g Pu/L with 1 N HNO_3 and 3.1% Pu-240 content.

4. LA-10860-MS, Figure 34 gives an infinite slab thickness of 5.3 cm for an water-reflected slab containing $Pu(NO_3)_4$ solution at 200 g Pu/L with 1 N HNO_3 and 3.1% Pu-240 content.

4.2 Description of Models

Decontamination activities in the PPC will require the use of an elevating platform to access piping, vessels, structural material located at elevated locations in the cell. Cut pipe sections removed during decontamination activities will be staged on this work platform until the platform is lowered to ground level and equipment removed during decontamination activities, including cut pipe sections, are transferred out of the cell for disposal. Plutonium process and utility piping transferred out of the cell will be located in an ex-cell staging area pending assay to ensure that the packaged wastes do not exceed the fissile mass packaging criteria of PSR-6. A basket that will provide for the convenient staging of cut pipe sections on both the in-cell platform and in the assay area has been proposed to support cell decontamination. This section describes models that were used to evaluate the criticality safety of proposed designs for baskets that will be used for staging plutonium process and utility piping in the PPC. In addition, several accident scenarios were developed to assess the implications of placement of packaged and unpackaged fissile materials in the vicinity of the staged piping. The following assumptions were made for model components:

PPC Piping:
All piping was assumed to be 1.5 in (nominal) schedule 80 pipe composed of 304L stainless steel. This piping has an outer diameter of 1.9 in (4.83 cm) and an inner diameter of 1.5 in (3.81 cm). Although the cell contains little pipe of the analyzed dimension in plutonium process and utility systems, it was selected because it results in the greatest areal concentration of fissile material in the staged configuration. Nominal 1.5 in. schedule 80 pipe has a wall thickness of 0.2 in (0.51 cm). All pipe sections were assumed to be 36 in (91.4 cm) in length, which is conservative relative to the 30 in (76.2 cm) anticipated lengths of pipe that are expected to be generated during decontamination activities. The evaluated models assume that pipe sections are half-filled with an homogenous solution of $Pu(NO_3)_4$ containing plutonium at the maximum concentration processed by NFS (200 g Pu/L) with no credit taken for Pu-240, which adds negative reactivity to solution systems.

Staging Basket:
The staging basket was modeled as a three-dimensional, rectangular structure. No credit was taken for the material composition and any associated shielding or spacing provided by the staging basket. The basket height dimension was fixed at 36 in (91.4 cm) and the length was assumed to be either 16 ft (4.88 m) or 50 ft (15.2 m), either of which is effectively infinite for the considered source material. The height of the basket was selected to correspond to the height of the cut pipe sections and can be shorter, if desired. Criticality evaluations were performed to assess the criticality safety of the basket for various dimensions of basket width.

Concrete Reflection:
It was assumed that under normal staging conditions reflection would be provided underneath the staging basket and along the length of the basket by concrete having a thickness of 3 ft (91.4 cm) and a specific gravity of 2.35 g/cm^3. Certain models assumed concrete reflection along additional dimensions (which will be noted when model results are presented).

Reflection by Workers:
Models of normal staging conditions assumed reflection by workers in the PPC. For these models, three workers were assumed to be standing side-by-side and were represented by a rectangular solid, composed entirely of water, having dimensions 4.5 ft (137.2 cm) (length) x 1 ft (30.5 cm) (width) x 6 ft (182.9 cm) (height).

4.3 Assumptions

Parameters and considerations used in this NCSE are documented and accompanied by the rationale for the assumptions that were made. This documentation is sufficient to allow another qualified individual to conduct an independent review.

Primary assumptions used in the development of the analytical models are:

- All fissile material is an homogenous solution of $Pu(NO_3)_4$ at 200 g Pu/L.
- No greater than 50% of the internal void area of individual pipe sections is occupied by $Pu(NO_3)_4$ solution. Pipes will be tell-taled and drained prior to cutting to ensure that any residual liquids have been removed. Previous decontamination and flushing activities are expected to have removed any residual accumulated deposits.
- The system contains no Pu-240, which would have the affect of adding negative reactivity to the analyzed system.
- Reflection is provided by 3 feet (91.44 cm) of ordinary concrete having a density of 2.35 g/cm^3 along the back and on the bottom of the staging basket. Areas where pipe sections from the PPC are anticipated to be staged have been provided with substantial shield walls to protect workers from radiation levels associated with accidents in-cell.
- There are no credible scenarios for significant internal or external moderation of the waste package. Partial moderation of the region around the pipe was represented by reduced density (i.e., 0.01 g/cm^3) water.
- There are no other unanalyzed fissile material sources in the staging area.
- There is no plutonium process or utility piping that has an inner diameter exceeding 1.5 in (3.81 cm).

5.0 DISCUSSION OF CONTINGENCIES

A contingency is defined as “a possible but unlikely change in a condition/control important to the nuclear criticality safety of a fissionable material operation that would, if it occurred, reduce the number of barriers (either administrative or physical) that are intended to prevent an accidental nuclear criticality” (DOE-STD-3007-93). Parameters considered in the contingency analysis for PPC piping are discussed in Section 5.1.

5.1 Parameter Discussion

The following parameters represent various means by which reactivity can be added to the system. A discussion of each will be made to demonstrate that the PPC piping will be double contingent under all normal and credible accident conditions.

- **Mass:** Mass can be added to the system only through a higher concentration of fissile solution, a change in volume, or an increase in enrichment. Therefore, mass is not independent of volume, enrichment, and concentration. Piping selected for evaluation have the greatest internal volume of any piping associated with plutonium processes and utilities. The enrichment of Pu-239 in the source solution selected for analysis represents the greatest processed by NFS and excludes the contribution to negative reactivity associated with Pu-240. The concentration of Pu in the source solution also represents the greatest concentration processed by NFS. Mass is not controlled.

- **Volume**: The volume of plutonium process and utility piping is bounded by the pipe size selected for analysis. Pipe dimensions in this system range from a nominal dimension of 0.125 inches to 1.5 inches. Pipe selected for analysis was nominal 1.5 inch pipe Therefore, volume is not controlled.

- **Shape**: Pipe removed from the PPC will be staged in a basket that provides for criticality safety. To ensure that criticality safety is maintained during staging it will be necessary to ensure that the staging container has been constructed to maintain a sufficient degree of neutron leakage. In this case, one of the lateral dimensions of the container (depth) was limited to ensure that a critical configuration of plutonium-contaminated pipe would not result. Shape is therefore controlled to ensure favorable geometry.

- **Density**: Piping removed from the PPC will not be subjected to any physical extremes nor will it be subjected to a condition in which any residual contained material could react in way in which density is changed. Density is not controlled.

- **Concentration**: The concentration of plutonium in the solution selected for analysis is equal to the greatest concentration in any NFS product solution. No mechanisms for concentration of this solution has been identified. Concentration is not controlled.

- **Moderation**: Significant moderation of staged pipe sections is not anticipated under normal conditions or anticipated abnormal conditions. Staged pipe sections will be sleeved to minimize contamination of plant areas. This sleeving will protect piping from internal moderation due to phenomena such as roof leaks. Areas where piping will be staged are elevated and not threatened by flooding. Moderation of interstitial areas around staged pipe sections have been modeled by assuming these areas are occupied by reduced-density water. The source material itself is liquid and therefore produces a thermalized flux. Moderation is not controlled.

- **Enrichment**: The design conditions are based on the assumption that the fissile material is fully enriched. The PPC piping is safe for high enrichment (96 w/o Pu-239). At the low enrichment, the PPC piping is safe under all the accident scenarios postulated in this NCSE. Enrichment is not controlled.

- **Absorbers**: There are no absorbers associated with PPC piping. Absorbers are not a contingency.

- **Reflection**: Reflection is assumed to be provided by concrete along the back and on the bottom of the staging basket and by operators in the vicinity of the basket. No other significant sources of material reflection have been identified. Reflection is not controlled.

- **Interaction**: Interaction of staged piping containing significant quantities of fissile material with other unanalyzed fissile material sources may result in an unsafe condition. Although piping removed from the PPC will be drained prior to handling, a fissile material assay will not be available prior to packaging. Consequently, controls will be imposed to limit the interaction of piping with other fissile material sources while staged pending assay. Interaction is controlled.

6.0 EVALUATION AND RESULTS

Evaluations were performed for several normal and credible abnormal or accident conditions. Configurations were selected to maximize reactivity under each of the evaluated conditions. The general analytical approach involved evaluation of a case using MCNP with an independent verification evaluation performed using the KENO criticality code system. Results for all cases are presented in Appendix A.

6.1 Normal Conditions

Under normal conditions, the staging basket was assumed to be filled with pipe sections from the PPC. Dimensions of the pipe sections and the staging basket were as noted in Section 4.2. In particular, pipe sections were assumed to be 36 in (91.4 cm) in length and two of the basket's dimensions were fixed: the height at 36 in (91.4 cm) and the length at 50 ft (15.2 m). Criticality evaluations were performed to determine the allowable range for the basket's width.

All pipe sections were assumed to be 50 percent full of an homogenous solution of $Pu(NO_3)_4$ containing plutonium at the maximum concentration processed by NFS (200 g Pu/L) and with no credit taken for Pu-240. The solution was modeled as an annular distribution on the inner pipe wall surface. The assumption that pipe sections are half full of $Pu(NO_3)_4$ solution is believed to be conservative for the following reasons:

- Historical process information indicates that PPC piping was flushed prior to shutdown of NFS operations.

- Per work instructions, piping is to be drained prior to cutting and removal from the PPC. A number of methods may be used to verify that piping has been drained, including tell-taling.

- Reported radiation levels of removed piping has not indicated the presence of Pu accumulation in cell piping.

Under normal conditions, reflection was assumed to be provided underneath the staging basket and along the length of the basket by concrete having a thickness of 3 ft (91.4 cm). Reflection by workers, situated directly next to the basket and represented by the dimensions described in Section 4.2, was also assumed.

An iterative process was used to determine the maximum allowable basket width that satisfied the stated criterion of k_{eff} + 2F < 0.93 under normal conditions. This process determined that a basket width of 15 in (38.1 cm) is acceptable. The k_{eff} + 2F for this case (Case 5Abin13 in Appendix A) was 0.91460. A verification analysis assuming the same geometric parameters (Case 15PIP155) calculated a k_{eff} + 2F of 0.9058.

6.2 Abnormal Conditions

Three abnormal or accident conditions were considered for PPC piping:

(1) A scenario identical to the normal condition case described in Section 6.1, except that un-cut cell piping full of $Pu(NO_3)_4$ solution containing 200 g Pu/L is located 2 ft (61 cm) above a basket filled with pipe that itself is half full of $Pu(NO_3)_4$ solution containing 200 g Pu/L. This model was selected to assess the most reactive credible in-cell condition. The calculated k_{eff} + 2F for this case was found to be 0.91663 (Case 5Abin26 of Attachment A). A verification analysis for this case calculated a k_{eff} + 2F of 0.9121 (Case 15PIP155G of Attachment A).

(2) A scenario identical to the normal condition case described in Section 6.1, except that eight additional sources are placed next to the staging bin. These sources represent drums of fissile material that have been packaged to meet the criteria of PSR-6. Each source is a sphere of $Pu(NO_3)_4$ containing 125 g of plutonium. The spheres were placed immediately adjacent to the staging basket and were spaced 22 in. (55.88 cm) on center to reflect the spacing that would be provided by 55-gallon drums. The calculated k_{eff} + 2F for this case was found to be 0.91663 (Case 5Abin27 of Attachment A). A verification analysis for this case calculated a k_{eff} + 2F of 0.9121 (Case 15PIP155E of Attachment A).

(3) An configuration of pipe sections arranged in a square array and reflected by concrete on two sides and underneath. The square array was assumed to have lateral dimensions (i.e., length and width) of 24 in (61.0 cm) and a height of 36 in (91.4 cm). This analysis assumed that pipe sections were 50 percent full of an homogenous solution of $Pu(NO_3)_4$ containing plutonium at 200 g Pu/L, with no credit taken for Pu-240. This scenario corresponds to the condition in which either a) an upset occurs with the staging basket, or b) piping is inadvertently placed against the staging basket. The calculated k_{eff} + 2F for this case was found to be 0.91663 (Case 5Abin17 of Attachment A). A verification analysis for this case calculated a k_{eff} + 2F of 0.9121 (Case SQ24 of Attachment A).

6.2.1 Hazard Identification

6.2.1.1 Hazard Evaluation Technique

This section identifies the hazards assessment methodology used to evaluate process hazards. Table 1 in Section 6.2.1.2 displays the results of ‘What If’ scenarios that were used to identify various upsets that could possibly add reactivity to the system. There are a total of eight cases, each of which is discussed in detail in Section 6.2.2, Criticality Hazard Analysis.

6.2.1.2 Hazards Identified

The following table was generated by considering various means by which reactivity can be added to the system and through discussions with process personnel on how various processes can fail.

Table 1

Hazard Identification for Staging of Pipe Removed from the PPC

Case	What If	Hazard/ Consequence	Safeguard	Comment
1	Concentration exceeds the nominal expected.	Increases reactivity.	Pipes are assumed to contain $Pu(NO_3)_4$ solution at the max concentration processed by NFS (200g Pu/L)	
2	Enrichment exceeds the nominal assumed.	Increases reactivity.	Pu-239 enrichment is greater than any actually processed by NFS. No Pu-240 assumed in the analyses.	
3	Pipes become moderated due to roof leakage.	Increases reactivity.	Staging basket designed to prevent the accumulation of water.	Nominal moderation around staged pipes has been assumed.
4	Pipes becomes fully reflected by water on the outside.	Increases reactivity.	Full reflection along back and underneath is assumed in analysis. Flooding in the staging area is incredible.	
5	An operator places an item containing fissile material next to basket containing pipe.	Increases reactivity.	Buffer area maintained around staging basket in assay area of PPH.	Analysis shows one drum or several pipe sections placed next to and outside of full staging basket is safe.
6	Pipe falls out of staging basket into less favorable geometry.	Increases reactivity.	Staging baskets will be designed to minimize the potential for overturning.	Analyses have shown that areas of accumulation having cross-sectional dimensions greater than the staging basket are safe.
7	Multiple pipe sections having a cross-sectional area equal to the staging basket are transferred from the PPC to the ex-cell staging basket.	None.	The weight of multiple pipe sections will prevent significant quantities of pipe from being transferred at any one time.	Analyses have shown that areas of accumulation having cross-sectional dimensions greater than the staging basket are safe.
8	The pipe contains a greater mass of fissile material than assumed.	Increases reactivity.	The analysis has assumed the maximum credible volume for piping from the cell as well as the maximum concentration of Pu processed by NFS.	

6.2.2 Criticality Hazard Analysis

This section provides arguments for each criticality hazard identified in Section 6.2.1.2. A discussion of each hazard will demonstrate that the evaluated PPC vessels are safe under all normal and credible accident conditions.

Case 1: Concentration exceeds the nominal expected.
The maximum product concentration processed by NFS was 200 g Pu/L. This concentration was used in all analyses. The results are tabulated in Appendix A. Even if every pipe section is 50% filled with $Pu(NO_3)_4$ at the maximum plutonium concentration of 200 g Pu/L and the system is fully reflected on the bottom and along the back by concrete the system is subcritical (k_{eff} + 2F < 0.93).

Case 2: Enrichment exceeds the nominal assay processed by NFS.
Analysis shows that the scenario is subcritical even when the maximum enrichment (96 w/o Pu-239) is used and the negative reactivity effects of Pu-240 are not included. See Appendix A for all calculations involving 96 w/o enriched plutonium.

Case 3: Pipes become moderated due to roof leakage.
Pipes will be staged in interior areas of the Main Plant building not typically prone to exposure to water infiltrating due to roof leakage. Sleeving on the pipes provided for contamination control will prevent internal moderation of piping due to roof leakage. The staging basket design will prohibit the accumulation of water around the pipes. Minimal moderation of the interstitial areas of stored pipe has been included in the evaluation by assuming that these areas are filled with reduced density water.

Case 4: The staging basket becomes fully reflected by water on the outside.
Fully reflecting the container would involve water levels in the staging area greater than three feet deep. Since the potential for flooding to this extent is not credible (as discussed in Section 6.2.3), reflection is considered to be an incredible event. Normal operations involve removing piping from the PPC and placing it in a staging basket. If an operator placed a section of pipe next to a full staging basket, the system would remain subcritical (see tables in Appendix A).

Case 5: An operator places an item containing fissile material next to the staging basket.
Introduction of un-analyzed fissile material sources into the staging area will be administratively controlled. Analysis has shown that a 55-gallon drum filled to the fissile material limit permitted by PSR-6, Fissile Material Packaging and Storage Requirements, or several pieces of fissile-bearing process piping may be placed next to and outside of the staging bin and criticality safety will be maintained.

Case 6: An upset results in over-turning of the staging basket.
The staging basket design will incorporate measures to protect against inadvertent over-turning. Analyses of systems containing both full and 50% full pipes has shown that an upset condition that results in a cross-section of spilled piping that is greater than the depth of the staging basket is safe (see tables in Appendix A).

Case 7: Multiple pipe sections having a cross section greater than the basket are transferred from the cell at one time.
Analyses have shown that certain collections of pipe having cross-sectional areas greater than the depth of the staging basket are safe. It is expected that this condition is self-limiting due to weight of this amount of piping (>240 pounds).

Case 8: The mass of fissile material in staged piping significantly exceeds the assumed amount. Analyses of plutonium process and utility piping have assumed that all piping in the staging area is 50% full of plutonium solution. Piping and vessels in the PPC were flushed and drained during NFS decontamination activities in the cell. These activities were designed to remove and recover residual deposits of plutonium. All process and utility pipes will be drained prior to removal.

6.2.3 Flooding Potential Due to Natural Phenomena

The likelihood of flooding PPC pipe sections placed in a staging basket is extremely small because "the site's topographic setting renders the likelihood of major flooding not credible, and local run-off and flooding is adequately accommodated by natural and man-made drainage systems in and around the WVDP," as stated in WVNS-SAR-001, *Safety Analysis Report for Waste Processing and Support Activities*; (2) waste containers will not be stored in locations below grade; and (3) waste containers will be vented with a HEPA filter that can withstand at least 122 cm (48 in) water column without allowing water entry into a container (Nuclear Filter Technology Incorporated NucFil 013 filter with Gore-Tex, or equivalent).

Chapter 3 of WVNS-SAR-001 provides an extensive discussion of surface hydrology phenomena associated with the WVDP site and surrounding area that presents facts and analyses supporting the conclusion that major flooding is not considered credible. Section 3.4.2.1 of WVNS-SAR-001 states that, "Historical evidence and computer modeling indicate that flood conditions (including the probable maximum flood) will not result in stream flows overtopping their banks and flooding the plateau."

Under conditions of the probable maximum flood (PMF), it is observed in Section 3.4.3 of WVNS-SAR-001 that, "The lowest portion of the Main Plant is approximately 1,410 feet NGVD, whereas under PMF conditions, the nearest stream would rise to only 1347.2 feet NGVD." Per section 3.4.2.2 of the SAR, "In the case of the hypothetical PMF, which has a peak discharge nearly eight times that of the 100-year flood, it was demonstrated...that culvert headwaters would overtop Rock Springs Road and some part of the floodwaters would flow across the plant area. Based on the topography in the plant area, it is likely that some portions of the site would experience shallow flows of moderate velocity. Flows would recede quickly, however, since the ditches that drain the site have gradients of up to 5%."

Finally, regarding a probable maximum precipitation (PMP) event, Section 3.4.2.3 of WVNS-SAR-001 states that, "The 24-hour PMP for this watershed as supplied by the U.S. Weather Bureau is 24.9 inches. The effects of the PMP on site drainage systems would be overwhelming. Capacities of storm drain inlets at grade and in sumps would be exceeded. Ditches along open section roadways would overflow, flooding roadways and adjacent areas. None of the culverts within the watershed would be expected to prevent overtopping of its embankments, which raises the possibility of embankment failures. In the case of the 24-inch corrugated metal pipe (CMP) culvert beneath the railroad embankment along Frank's Creek...flow would be directed to the water supply reservoirs before the embankment elevation was exceeded. Failures of culvert embankments would not threaten any safety-related facilities in the plant area."

7.0 DESIGN FEATURES (PASSIVE AND ACTIVE) AND ADMINISTRATIVELY CONTROLLED LIMITS AND REQUIREMENTS

The criticality analysis has evaluated a normal storage configuration in which pipes removed from the PPC are staged in a basket having a depth that ensures criticality safety. Based on the included analyses it is concluded that a staging basket having a depth dimension not exceeding 15" (38.1 cm) will be safe under all normal and credible abnormal conditions. Furthermore, the basket shall be designed to minimize the retention of accumulated water to minimize the potential for external moderation of the staged piping.

8.0 SUMMARY AND CONCLUSIONS

Plutonium process and utility piping from the Product Purification Cell may be removed and staged in a manner that ensures criticality safety. The analysis in this NCSE incorporates very conservative assumptions regarding the residual fissile inventory in the piping. Prior to removal, piping will be drained to minimize the potential for the release of highly radioactive liquid wastes. Therefore, it is very conservative to assume that this piping contains significant quantities of product solution at the maximum concentrations processed by NFS.

Under normal conditions, plutonium process and utility piping will be staged in critically safe staging baskets in areas where no other fissile material waste packages will be handled. Even when other wastes are introduced into the area in a manner that increases reactivity, the resulting k_{eff} + 2F is 0.91846, which is subcritical by a wide margin.

Abnormal operations and accident conditions considered the possibility of several pipe sections containing fissile materials at levels not expected based on process knowledge and operator oversight. Even when a 24 inch x 24 inch (61 cm x 61 cm) array of pipe sections completely filled with $Pu(NO_3)_4$ at the maximum Pu concentration results due to operator error or upset conditions, the resulting k_{eff} + 2F was found to be 0.92916.

It is therefore concluded that the plutonium process and utility piping from the PPC may be safely staged in the proposed storage configuration.

9.0 REFERENCES

American Nuclear Society. ANSI/ANS 8.1. *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*. 1983.

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APPENDIX A

TABULATED RESULTS

Table A-1. Results of MCNP Estimates of k_{eff} for PPC Piping.

Case	Description	k_{eff}	F	k_{eff} + 2F
5Abin13	Storage bin 50' long x 3' high x 15" wide filled with square lattice array of 1-1/2" pipes half full of $Pu(NO_3)_4$ containing 200g Pu/L. Reflection on back and bottom by 3' of ordinary concrete and in front by 3 operators.	0.90686	0.00387	0.91460
5Abin26	Same as Case 5Abin13 but pipes filled with $Pu(NO_3)_4$ containing 200g Pu/L located 2' above and extending 40' up. Pipes are centered over basket and are spaced 6" on center.	0.90989	0.00337	0.91663
5Abin27	Same as Case 5Abin13 except eight drums containing 125g Pu assumed to be located adjacent to pipes in bin. Sources in each drum assumed to be sphere of $Pu(NO_3)_4$ containing 200g Pu/L.	0.91118	0.00364	0.91846
5Abin17	Square array of pipes 24" wide x 24" long x 36" high. Pipes in array arranged in hexagonal lattice and assumed to be half full of $Pu(NO_3)_4$ containing 200g Pu/L. Reflection provided on bottom and two sides by 3' of ordinary concrete.	0.92216	0.00350	0.92916

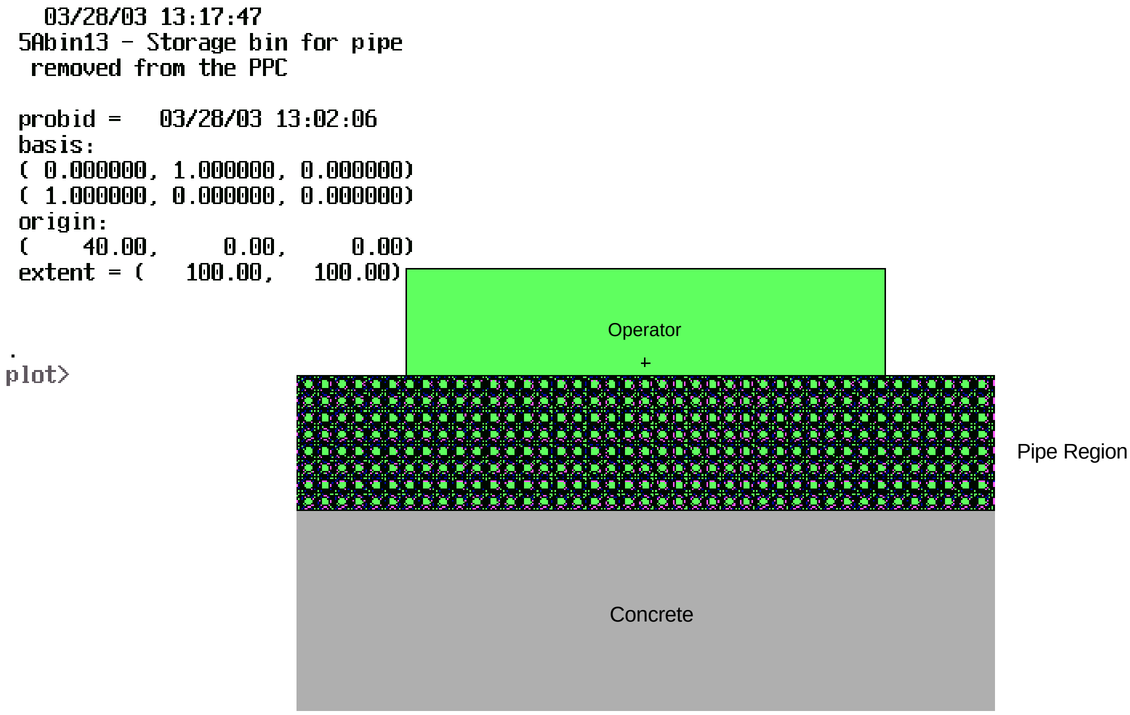
Table A-2. Results of KENO V.a Estimates of k_{eff} for PPC Piping.

Case	Description	k_{eff}	F	k_{eff} + 2F
15PIP155	Storage bin 50' long x 3' high x 15" wide filled with square lattice array of 1-1/2" pipes half full of $Pu(NO_3)_4$ containing 200g Pu/L. Reflection on back and bottom by 3' of ordinary concrete and in front by 3 operators.	0.9040	0.0009	0.9058
15PIP155G	Same as Case 15PIP155 but pipes filled with $Pu(NO_3)_4$ containing 200g Pu/L located 2' above and extending 40' up. Pipes are centered over basket and are spaced 6" on center.	0.9069	0.0026	0.9121
15PIP155E	Same as Case 15PIP155 except eight drums containing 125g Pu assumed to be located adjacent to pipes in bin. Source assumed to be sphere of $Pu(NO_3)_4$ containing 200g Pu/L.	0.9079	0.0012	0.9103
SQ24	Square array of pipes 24" wide x 24" long x 36" high. Pipes in array arranged in hexagonal lattice and assumed to be half full of $Pu(NO_3)_4$ containing 200g Pu/L. Reflection provided on bottom and two sides by 3' of ordinary concrete.	0.8647	0.0018	0.8683

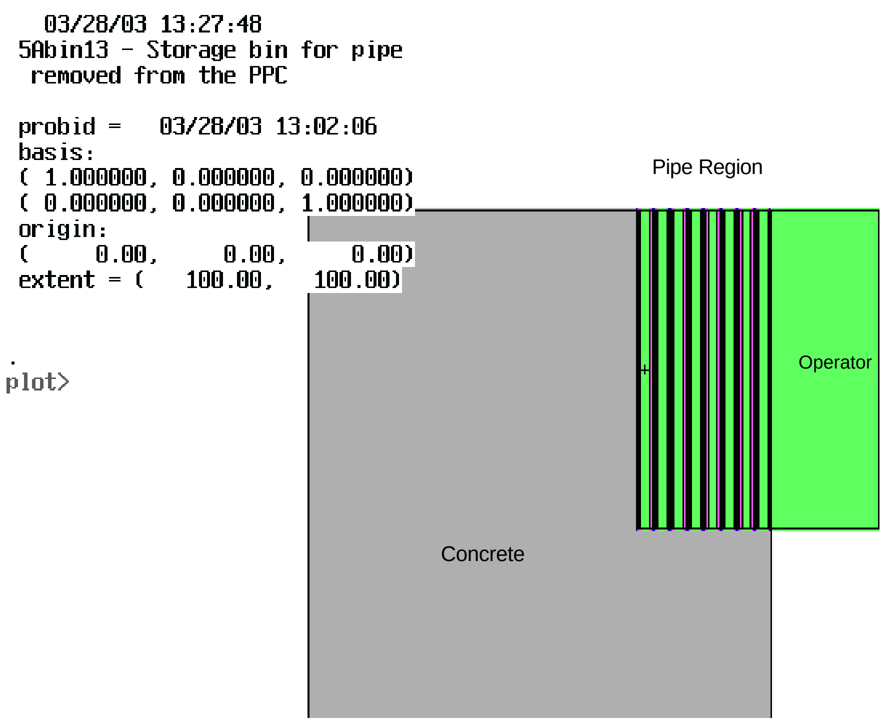
APPENDIX B

FIGURES

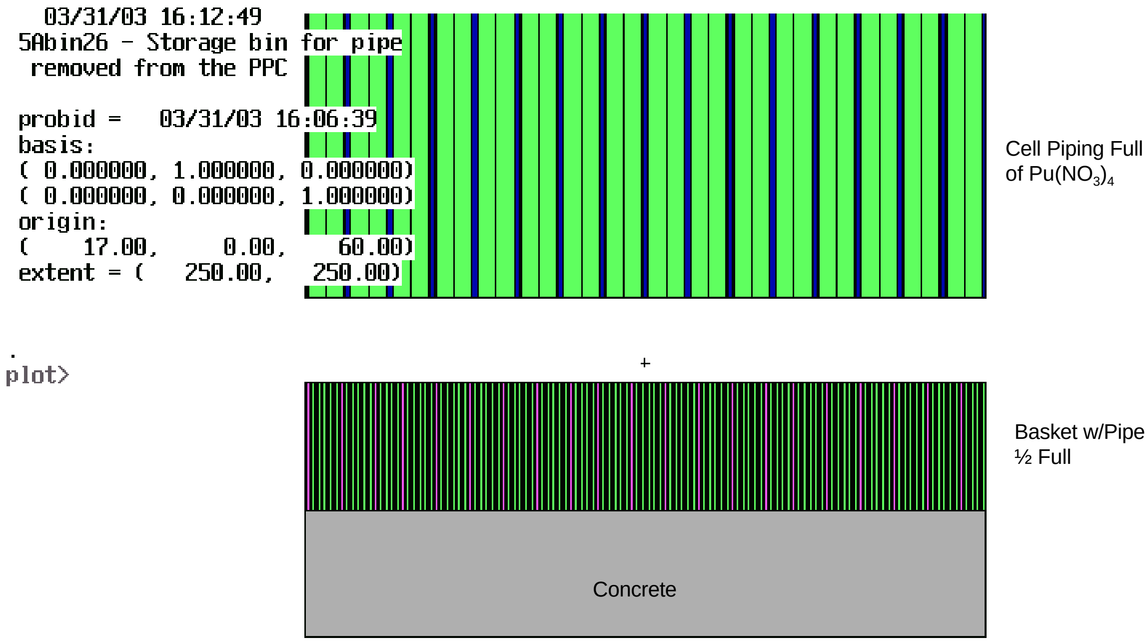
MCNP MODEL GRAPHICS



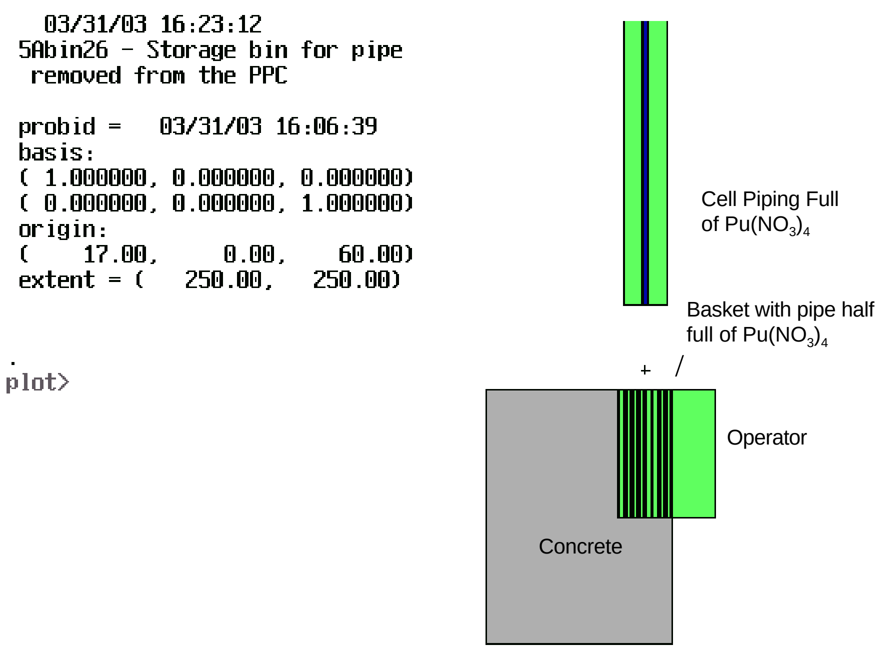
CASE 5Abin13 - Plan View: Normal Basket Configuration



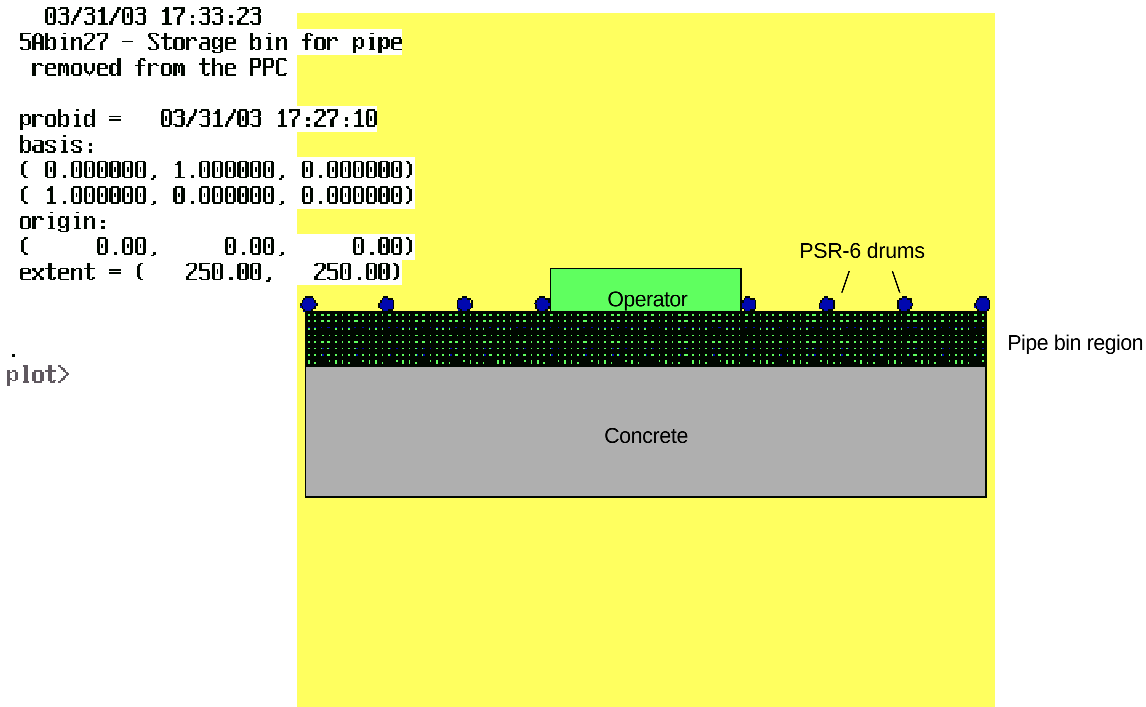
CASE 5Abin13 - Section View: Normal Basket Configuration



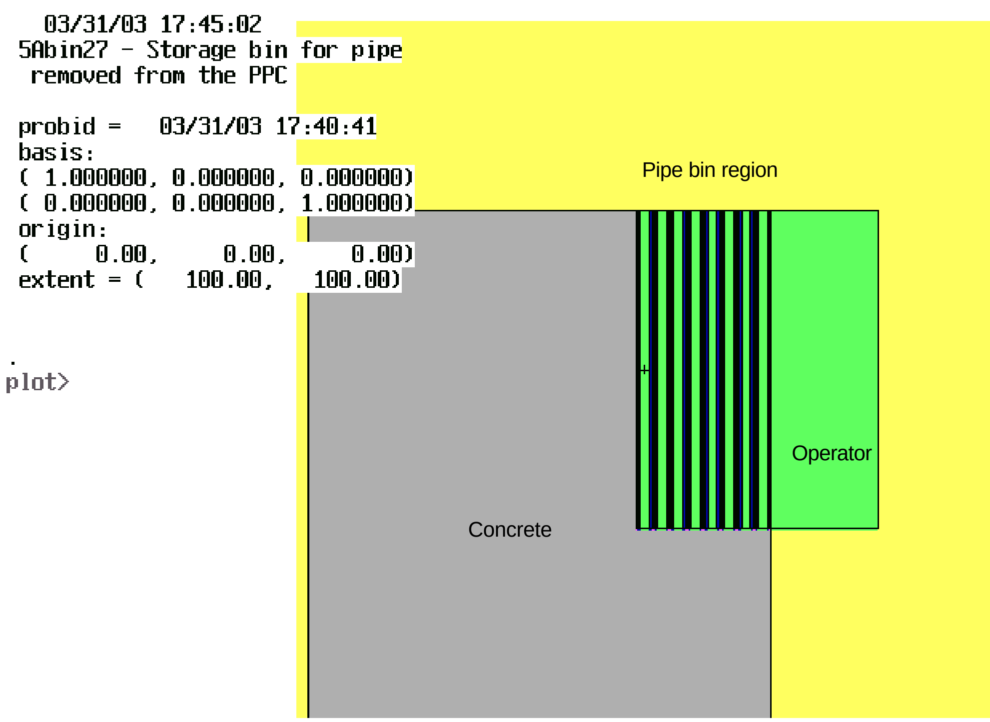
CASE 5Abin26 - Section View: Basket Configuration in Cell with Cell Piping 2' Above Basket



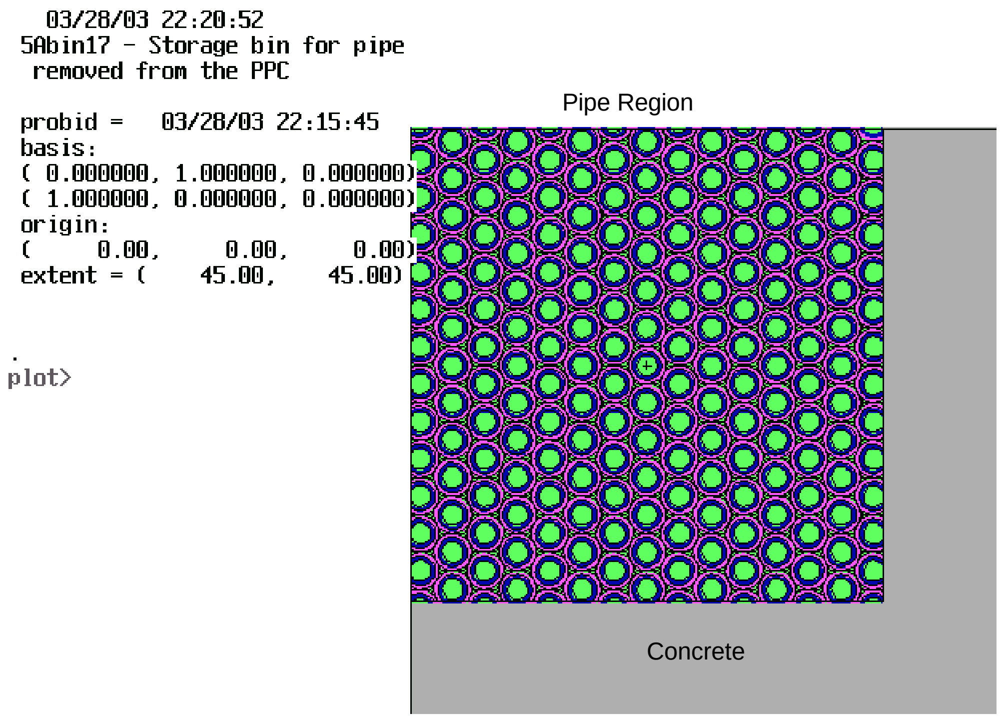
CASE 5Abin26 - Section View: Basket Configuration with Cell Piping 2' Above Basket



CASE 5Abin27 - Plan View: Basket Adjacent to 8 PSR-6 Drums each Containing 125g Pu

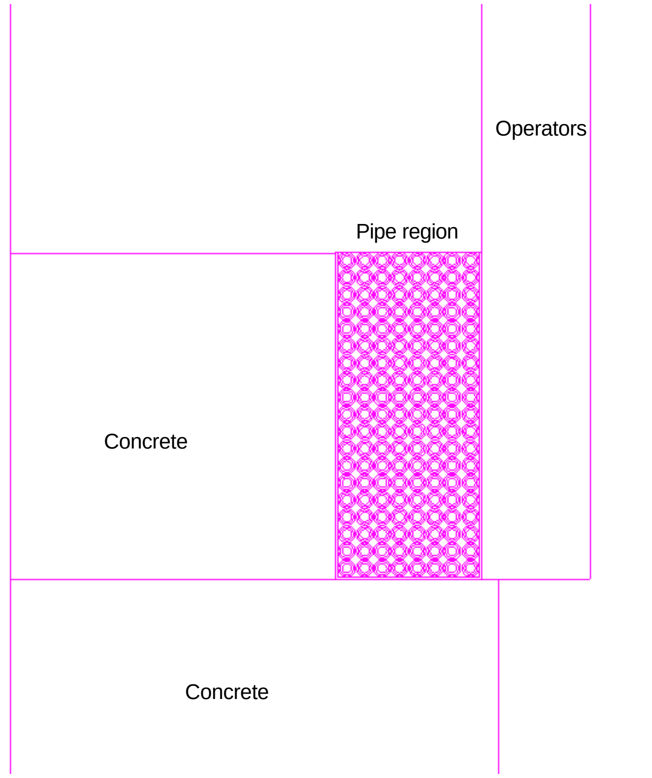


CASE 5Abin27 - Section View: Basket Adjacent to 8 PSR-6 Drums each Containing 125g Pu

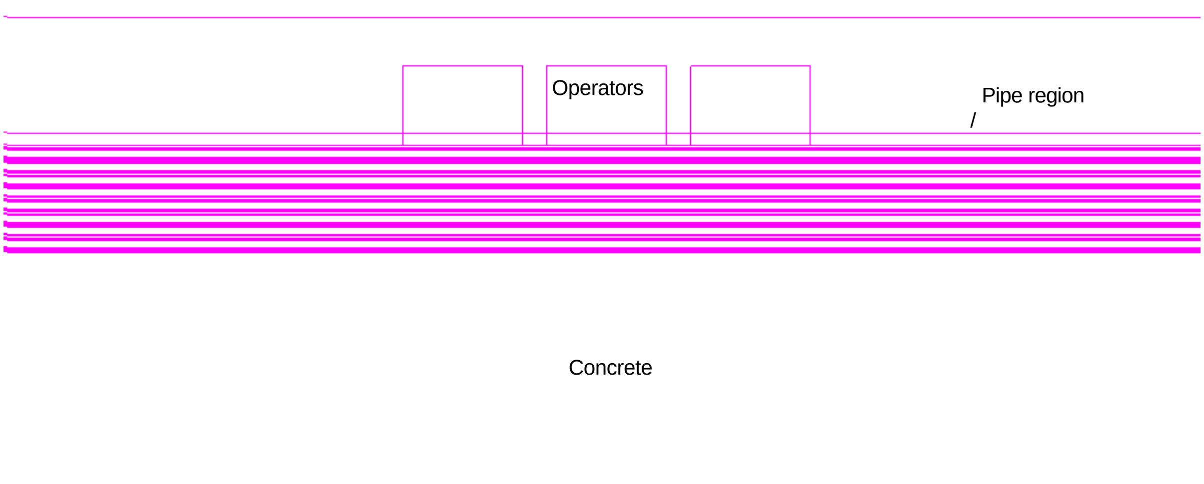


CASE 5Abin17 - Plan View: 24"x24" Array of 1-1/2" Pipe ½ Full

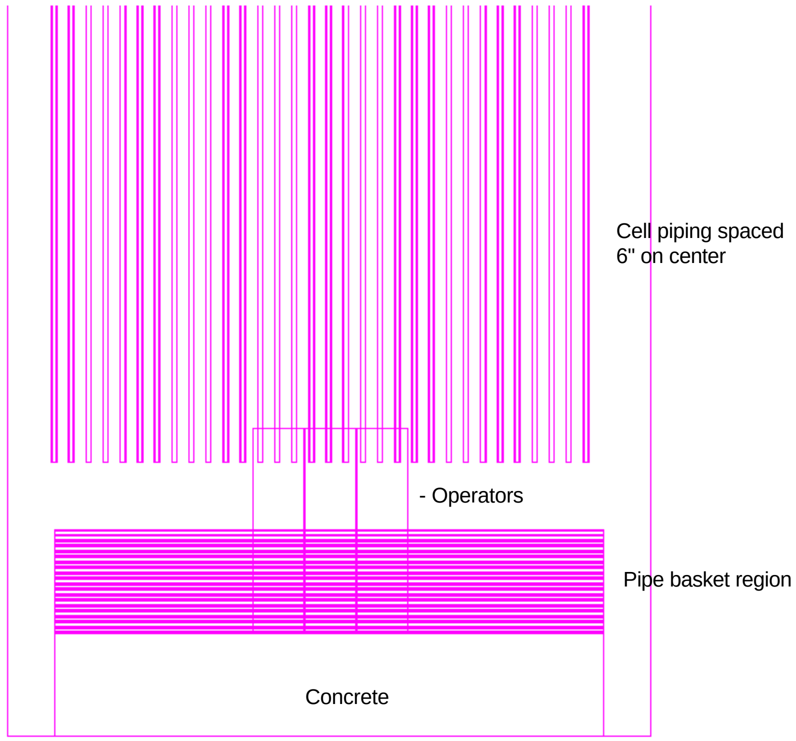
KENO MODEL GRAPHICS



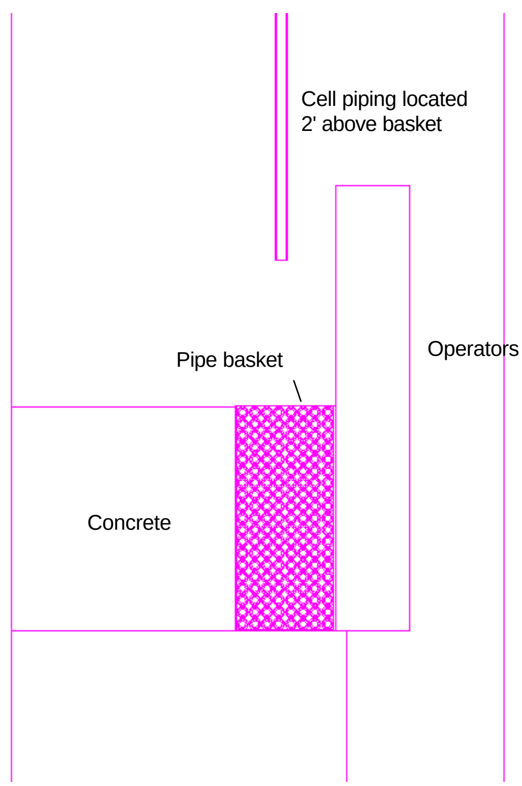
CASE 15PIP155 - Section View: Normal Basket Configuration



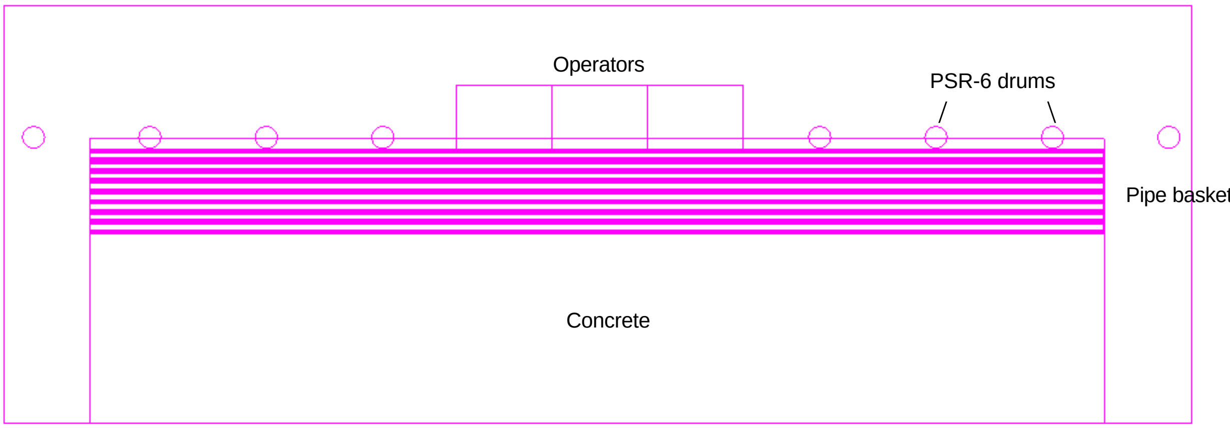
CASE 15PIP155 - Plan View: Normal Basket Configuration



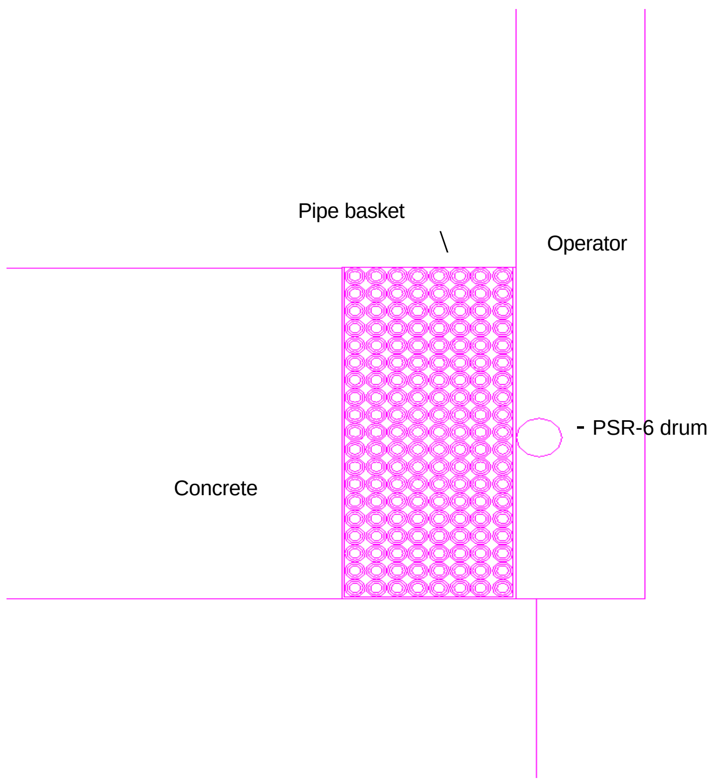
CASE 15PIP155G - Section View: Basket Configuration with Cell Piping 2' Above Basket



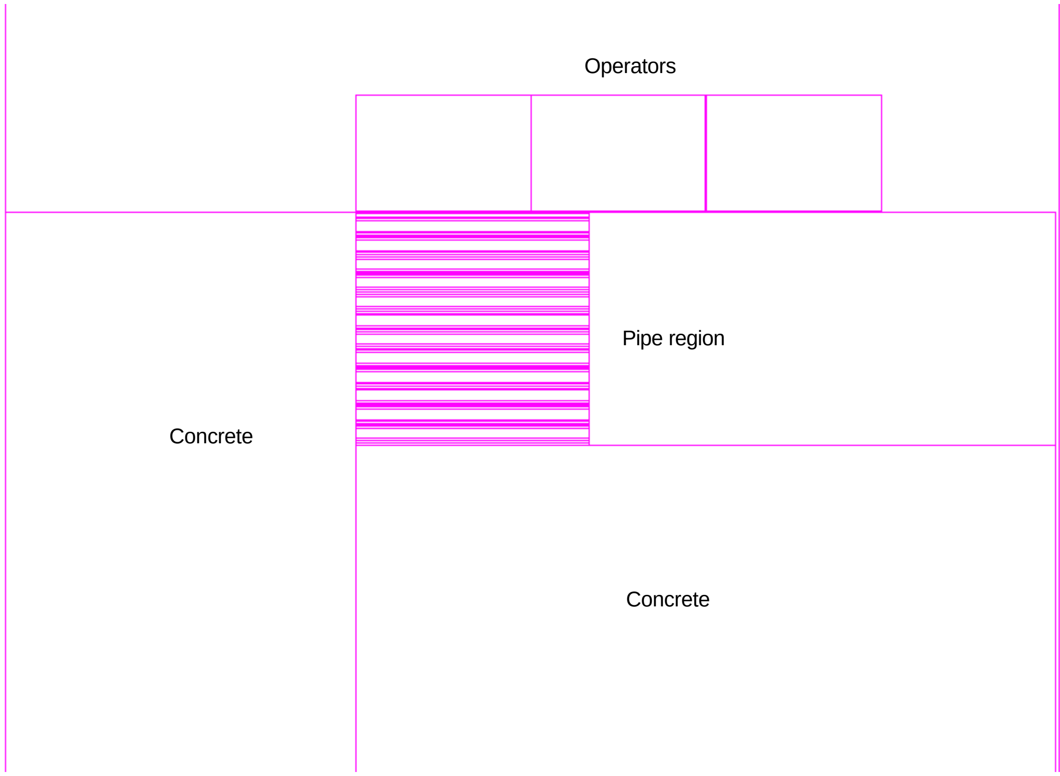
CASE 15PIP155G - Section View: Basket Configuration with Cell Piping 2' Above Basket



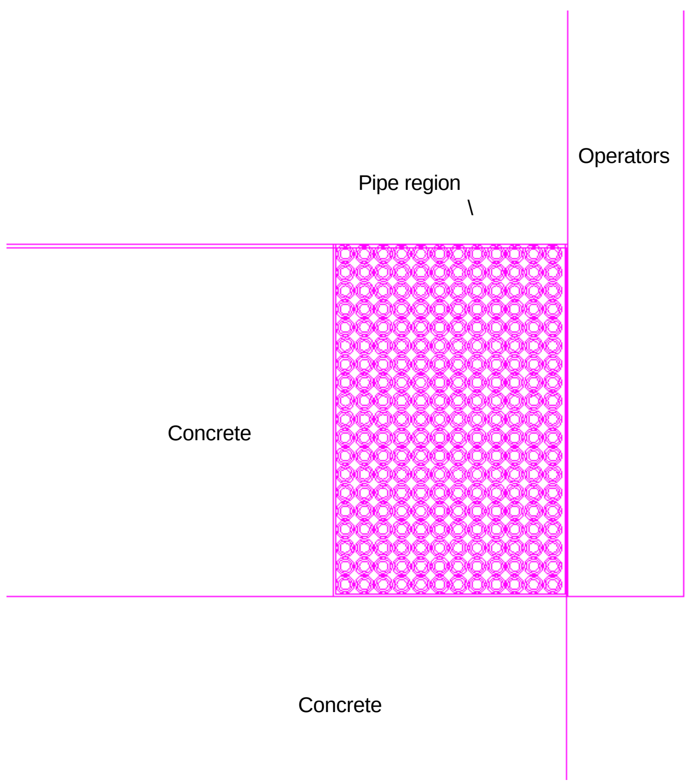
CASE 15PIP155E - Plan View: Basket Configuration with 8 PSR-6 Drums Containing 125g Pu



CASE 15PIP155E - Sect View: Basket Configuration with 8 PSR-6 Drums



CASE SQ24 - Plan View: 24" x 24" Square Array of 1-1/2" Pipe Half Full



CASE SQ24 - Section View: 24" x 24" Square Array of 1-1/2" Pipe Half Full

APPENDIX C

INPUT LISTINGS

5Abin13

```
5Abin13 - Storage bin for pipe removed from the PPC
c Model is 1-1/2" pipe sections half full of Pu(NO3)4 (200g Pu/L)
c Bin geometry: 50' in y-direction
c               15.19" in x-direction (8 widths of 1-1/2" pipe)
c               36" in z-direction
c Reflection:
c        front: 0" clearance from (3) 1'x1-1/2' operators
c         back: 0" clearance from 3' of concrete
c       bottom: 0" clearance from 3' of concrete
c Pipe sections in square array
c
c Cell cards
c
c
--------------------------------------------------------------------
c Bin area:
10 63 -0.001  -20     u=1             imp:n=1 $ void area in pipe
11 66 -1.334  -21 20  u=1             imp:n=1 $ pipe source area
12 62 -7.8    -22 21  u=1             imp:n=1 $ pipe wall
13 63 -0.01    22     u=1              imp:n=1 $ outside of pipe
14 0   30 -31 32 -33 lat=1 fill=1 u=2  imp:n=1 $ square lattice
15 0        1 -2 3 -4 5 -6 fill=2      imp:n=1 $ bin filled with pipe
c
52 67 -2.35 (-3:-1) 5 100 -6 -4 101 -2 imp:n=1 $ concrete reflection
54 63 -1.000   1 -2 4 -102 103 -104    imp:n=1 $ operator reflection
c
c Outside bin area:
101 0        -900 #15 #52 #54      imp:n=0 $ air in sphere
102 0            900               imp:n=0 $ outside world
c
--------------------------------------------------------------------
c
c Note: next line must be completely blank

c Surface cards
c
--------------------------------------------------------------------
c ***slab***
1 pz -45.72  $ bottom of bin
2 pz  45.72  $ top of bin (36")
3 px -2.4139 $ back wall of bin
4 px 36.1809 $ front wall of bin
5 py -762    $ left end of bin
6 py  762    $ right end of bin
c ***pipe parameters***
20 cz  1.347  $ source area
21 cz  1.905  $ inner wall of pipe
22 cz  2.413  $ outer wall of pipe
c ***lattice surfaces***
30 px -2.414
31 px  2.414
32 py -2.414
33 py  2.414
c ***reflection slab***
100 px -96.52  $ back wall
101 pz -137.16 $ floor reflection
c ***3 operators***
102 px  66.6609
103 py -68.58
104 py  68.58
c ***world sphere***
900 so  800
c
c
--------------------------------------------------------------------
c
c Note: next line must be completely blank

c Data cards
c
c Materials
c
c 5 w/o solid fuel (O-16, U-235, U-238)
m61   1001.50c 5.6221E-02
      8016.50c 3.8624E-02
      7014.50c 2.9898E-03
     92234.50c 3.0893E-07
     92235.50c 5.7830E-05
     92236.50c 5.1050E-07
     92238.50c 9.5450E-04
c Stainless Steel Pipe 304L (Si, Cr, Mn, Fe, Ni)
m62  14000.50c -0.01
     24000.50c -0.19
     25055.50c -0.02
     26000.55c -0.68
     28000.50c -0.10
c Water (H, O)
m63   1001.50c 0.666667
      8016.50c 0.333333
c Air (C, N, O, Ar) composition from Attix p. 523
m64   6000.50c -0.000124
      7014.50c -0.755267
      8016.50c -0.231781
     18000.35d -0.012828
c Carbon steel (C, Fe)
m65   6000.50c -0.005
     26000.55c -0.995
c Pu(NO3)4 Solution
m66   1001.50c 6.19542E-02
      7014.50c 2.01476E-03
      8016.50c 3.70214E-02
     94238.50c 2.17560E-06
     94239.55c 4.84386E-04
     94241.50c 1.45901E-05
     94242.50c 2.53764E-06
c Concrete (NBS Ordinary) from Harmon et. al. Criticality Calculation
c with MCNP. A Primer. p. C-5 (Elements: H, O, Na, Si, Al, Ca, Fe, K
c adjusted to sum to unity without minor trace elements)
m67   1001.50c -0.006
      8016.50c -0.5
     11023.50c -0.017
     13027.50c -0.048
     14000.50c -0.315
     19000.50c -0.019
     20000.50c -0.083
     26000.55c -0.012
c
mode n
print 40 60 80 100 110 126
kcode 800 0.9 40 140
ksrc 0 1.63 0
```

5Abin26

```
5Abin26 - Storage bin for pipe removed from the PPC
c Model is 1-1/2" pipe sections half full of Pu(NO3)4 (200g Pu/L)
c Bin geometry: 16' in y-direction
c               15.19" in x-direction (8 widths of 1-1/2" pipe)
c               36" in z-direction
c Reflection:
c        front: 0" clearance from (3) 1'x1-1/2' operators
c         back: 0" clearance from 3' of concrete
c       bottom: 0" clearance from 3' of concrete
c Pipe sections in square array
c Cell piping spaced above bin:
c       bottom: 2' above bin
c          top: 42' above bin
c      spacing: 6" on center
c
c Cell cards
c
c
--------------------------------------------------------------------
c Bin area:
10 63 -0.001             -20      u=1  imp:n=1 $ void area in pipe
11 66 -1.334          -21 20      u=1  imp:n=1 $ pipe source area
12 62 -7.8            -22 21      u=1  imp:n=1 $ pipe wall
13 63 -0.01               22      u=1  imp:n=1 $ outside of pipe
14 0           30 -31 32 -33
                     lat=1 fill=1 u=2  imp:n=1 $ square lattice
15 0          1 -2 3 -4 5 -6   fill=2  imp:n=1 $ bin filled with pipe
c
20 66 -1.334             -61      u=3  imp:n=1 $ pipe source area
21 62 -7.8            61 -62      u=3  imp:n=1 $ pipe wall
22 63 -0.01               62      u=3  imp:n=1 $ outside of pipe
23 0           65 -66 67 -68
                     lat=1 fill=3 u=4  imp:n=1 $ cell pipe lattice
24 0      55 -56 51 -52 5 -6   fill=4  imp:n=1 $ cell piping region
c
52 67 -2.35 (-3:-1) 5 100 -6 -4 101 -2 imp:n=1 $ concrete reflection
54 63 -1.000   1 -2 4 -102 103 -104    imp:n=1 $ operator reflection
c
c Outside bin area:
101 0        -900 #15 #24 #52 #54    imp:n=0 $ air in sphere
102 0         900                    imp:n=0 $ outside world
c
--------------------------------------------------------------------
c
c Note: next line must be completely blank

c Surface cards
c
--------------------------------------------------------------------
c ***staging bin***
1 pz -45.72  $ bottom of bin
2 pz  45.72  $ top of bin (36")
3 px -2.4139 $ back wall of bin
4 px 36.1809 $ front wall of bin
5 py -243.84 $ left end of bin
6 py  243.84 $ right end of bin
c ***bin pipe parameters***
20 cz  1.347  $ source area
21 cz  1.905  $ inner wall of pipe
22 cz  2.413  $ outer wall of pipe
c ***bin lattice surfaces***
30 px -2.414
31 px  2.414
32 py -2.414
33 py  2.414
c ***cell pipe region***
55 pz  106.68   $ bottom of cell pipe: 2' above basket
56 pz 1325.88   $ 40' length of cell pipe
51 px   1.6336  $ back of cell pipe region
52 px  32.1334  $ front of cell pipe region
c  pz  see surface 5
c  pz  see surface 6
c ***cell piping***
61 c/z 16.8835 0 1.905
62 c/z 16.8835 0 2.413
c ***cell pipe lattice surfaces***
```

```
65 px   1.6335
```

```
66 px  32.1335
67 py -15.25
68 py  15.25
c ***concrete reflection***
100 px -96.52  $ back wall
101 pz -137.16 $ floor reflection
c ***3 operators***
102 px  66.6609
103 py -68.58
104 py  68.58
c ***world sphere***
900 sz 600 1100
c
c
--------------------------------------------------------------------
c
c Note: next line must be completely blank

c Data cards
c
c Materials
c
c 5 w/o solid fuel (O-16, U-235, U-238)
m61   1001.50c 5.6221E-02
      8016.50c 3.8624E-02
      7014.50c 2.9898E-03
     92234.50c 3.0893E-07
     92235.50c 5.7830E-05
     92236.50c 5.1050E-07
     92238.50c 9.5450E-04
c Stainless Steel Pipe 304L (Si, Cr, Mn, Fe, Ni)
m62  14000.50c -0.01
     24000.50c -0.19
     25055.50c -0.02
     26000.55c -0.68
     28000.50c -0.10
c Water (H, O)
m63   1001.50c 0.666667
      8016.50c 0.333333
c Air (C, N, O, Ar) composition from Attix p. 523
m64   6000.50c -0.000124
      7014.50c -0.755267
      8016.50c -0.231781
     18000.35d -0.012828
c Carbon steel (C, Fe)
m65   6000.50c -0.005
     26000.55c -0.995
c Pu(NO3)4 Solution
m66   1001.50c 6.19542E-02
      7014.50c 2.01476E-03
      8016.50c 3.70214E-02
     94238.50c 2.17560E-06
     94239.55c 4.84386E-04
     94241.50c 1.45901E-05
     94242.50c 2.53764E-06
c Concrete (NBS Ordinary) from Harmon et. al. Criticality Calculation
c with MCNP. A Primer. p. C-5 (Elements: H, O, Na, Si, Al, Ca, Fe, K
c adjusted to sum to unity without minor trace elements)
m67   1001.50c -0.006
      8016.50c -0.5
     11023.50c -0.017
     13027.50c -0.048
     14000.50c -0.315
     19000.50c -0.019
     20000.50c -0.083
     26000.55c -0.012
c
mode n
print 40 60 80 100 110 126
kcode 400 1. 20 120
ksrc 0 0 0
     16.8835 0 300
     16.8835 0 600
     16.8835 0 900
     16.8835 0 1200
```

5Abin27

```
5Abin27 - Storage bin for pipe removed from the PPC
c Model is 1-1/2" pipe sections half full of Pu(NO3)4 (200g Pu/L)
c Bin geometry: 16' in y-direction
c               15.19" in x-direction (8 widths of 1-1/2" pipe)
c               36" in z-direction
c Reflection:
c        front: 0" clearance from (3) 1'x1-1/2' operators
c         back: 0" clearance from 3' of concrete
c       bottom: 0" clearance from 3' of concrete
c Pipe sections in square array
c PSR-6 spheres adjacent to bin and operator place 22" o.c.
c
c Cell cards
c
c
--------------------------------------------------------------------
c Bin area:
10 63 -0.001  -20     u=1              imp:n=1 $ void area in pipe
11 66 -1.334  -21 20  u=1              imp:n=1 $ pipe source area
12 62 -7.8    -22 21  u=1              imp:n=1 $ pipe wall
13 63 -0.01    22     u=1              imp:n=1 $ outside of pipe
14 0   30 -31 32 -33 lat=1 fill=1 u=2  imp:n=1 $ square lattice


      14000.50c -0.315
     19000.50c -0.019
```

```
15 0        1 -2 3 -4 5 -6 fill=2      imp:n=1 $ bin filled with pipe
c
52 67 -2.35 (-3:-1) 5 100 -6 -4 101 -2 imp:n=1 $ concrete reflection
53 63 -1.000   1 -2 4 -102 103 -104    imp:n=1 $ operator reflection
60 66 -1.334   -500                    imp:n=1 $ PSR-6 sphere
61 like 60 but trcl (0 55.88 0)        imp:n=1
62 like 60 but trcl (0 111.76 0)       imp:n=1
63 like 60 but trcl (0 167.64 0)       imp:n=1
70 66 -1.334   -501                    imp:n=1 $ PSR-6 sphere
71 like 70 but trcl (0 -55.88 0)       imp:n=1
72 like 70 but trcl (0 -111.76 0)      imp:n=1
73 like 70 but trcl (0 -167.64 0)      imp:n=1
c
c Outside bin area:
101 64 -0.000001 -900 #15 #52 #53 #60
           #61 #62 #63 #70 #71 #72 #73 imp:n=1 $ air in sphere
102 0           900                    imp:n=0 $ outside world
c
--------------------------------------------------------------------
c
c Note: next line must be completely blank

c Surface cards
c
--------------------------------------------------------------------
c ***slab***
1 pz -45.72  $ bottom of bin
2 pz  45.72  $ top of bin (36")
3 px -2.4139 $ back wall of bin
4 px 36.1809 $ front wall of bin
5 py -243.84 $ left end of bin
6 py  243.84 $ right end of bin
c ***pipe parameters***
20 cz  1.347  $ source area
21 cz  1.905  $ inner wall of pipe
22 cz  2.413  $ outer wall of pipe
c ***lattice surfaces***
30 px -2.414
31 px  2.414
32 py -2.414
33 py  2.414
c ***reflection slab***
100 px -96.52  $ back wall
101 pz -137.16 $ floor reflection
c ***3 operators***
102 px  66.6609
103 py -68.58
104 py  68.58
c ***PSR-6 spheres***
500 s  41.49  73.885 0 5.304
501 s  41.49 -73.885 0 5.304
c ***world sphere***
900 so  800
c
c
--------------------------------------------------------------------
c
c Note: next line must be completely blank

c Data cards
c
c Materials
c
c 5 w/o solid fuel (O-16, U-235, U-238)
m61   1001.50c 5.6221E-02
      8016.50c 3.8624E-02
      7014.50c 2.9898E-03
     92234.50c 3.0893E-07
     92235.50c 5.7830E-05
     92236.50c 5.1050E-07
     92238.50c 9.5450E-04
c Stainless Steel Pipe 304L (Si, Cr, Mn, Fe, Ni)
m62  14000.50c -0.01
     24000.50c -0.19
     25055.50c -0.02
     26000.55c -0.68
     28000.50c -0.10
c Water (H, O)
m63   1001.50c 0.666667
      8016.50c 0.333333
c Air (C, N, O, Ar) composition from Attix p. 523
m64   6000.50c -0.000124
      7014.50c -0.755267
      8016.50c -0.231781
     18000.35d -0.012828
c Carbon steel (C, Fe)
m65   6000.50c -0.005
     26000.55c -0.995
c Pu(NO3)4 Solution
m66   1001.50c 6.19542E-02
      7014.50c 2.01476E-03
      8016.50c 3.70214E-02
     94238.50c 2.17560E-06
     94239.55c 4.84386E-04
     94241.50c 1.45901E-05
     94242.50c 2.53764E-06
c Concrete (NBS Ordinary) from Harmon et. al. Criticality Calculation
c with MCNP. A Primer. p. C-5 (Elements: H, O, Na, Si, Al, Ca, Fe, K
c adjusted to sum to unity without minor trace elements)
m67   1001.50c -0.006
      8016.50c -0.5
     11023.50c -0.017
     13027.50c -0.048
```

```
     20000.50c -0.083
     26000.55c -0.012
c
mode n
print 40 60 80 100 110 126
kcode 400 1. 20 120
ksrc 0  1.626  0
     41.49 -241.525 0
     41.49 -185.645 0
     41.49 -129.765 0
     41.49  -73.885 0
     41.49   73.885 0
     41.49  129.765 0
     41.49  185.645 0
     41.49  241.525 0
```

5Abin17

```
5Abin17 - Storage bin for pipe removed from the PPC
c Model is 1-1/2" pipe sections full of Pu(NO3)4 (200g Pu/L)
c Square: 24" in y-direction
c         24" in x-direction
c         36" in z-direction
c Reflection:
c         side: 0" clearance from 3' of concrete
c         back: 0" clearance from 3' of concrete
c       bottom: 0" clearance from 3' of concrete
c
c Cell cards
c
c
--------------------------------------------------------------------
c Bin area:
10 0     -30 31 -32 33 -34 35  u=1
                      lat=2 fill=2    imp:n=1 $ hex lattice
11 63 -0.001  -20      u=2            imp:n=1 $ void area in pipe
12 66 -1.334   20 -21  u=2            imp:n=1 $ pipe source
13 62 -7.8     21 -22  u=2            imp:n=1 $ pipe wall
14 63 -0.01    22      u=2            imp:n=1 $ outside of pipe
15 0         1 -2 3 -4 5 -6 fill=1    imp:n=1 $ bin filled with pipe
c
52 67 -2.35 (-3:6:-1) 5 100 -101 -4 102 -2 imp:n=1 $ reflection
c
c Outside bin area:
101 0        -900 #15 #52          imp:n=0 $ air in sphere
102 0            900               imp:n=0 $ outside world
c
--------------------------------------------------------------------
c
c Note: next line must be completely blank

c Surface cards
c
--------------------------------------------------------------------
c ***slab***
1 pz -45.72 $ bottom of bin
2 pz  45.72 $ top of bin (36")
3 px -30.48 $ back wall of bin
4 px  30.48 $ front wall of bin
5 py -30.48 $ left end of bin
6 py  30.48 $ right end of bin
c ***pipe parameters***
20 cz  1.347  $ source area
21 cz  1.905  $ inner wall of pipe
22 cz  2.413  $ outer wall of pipe
c ***lattice surfaces***
30 p  -0.5  0.8660254 0  2.414
31 p  -0.5  0.8660254 0 -2.414
32 p   0.5  0.8660254 0  2.414
33 p   0.5  0.8660254 0 -2.414
34 px  2.414
35 px -2.414
c ***reflection slab***
100 px -182.88  $ back wall
101 py  182.88  $ side wall
102 pz -137.16 $ floor reflection
c ***world sphere***
900 so  800
c
c
--------------------------------------------------------------------
c
c Note: next line must be completely blank

c Data cards
c
c Materials
c
c 5 w/o solid fuel (O-16, U-235, U-238)
m61   1001.50c 5.6221E-02
      8016.50c 3.8624E-02
      7014.50c 2.9898E-03
     92234.50c 3.0893E-07
     92235.50c 5.7830E-05
     92236.50c 5.1050E-07
     92238.50c 9.5450E-04
c Stainless Steel Pipe 304L (Si, Cr, Mn, Fe, Ni)
m62  14000.50c -0.01
     24000.50c -0.19
     25055.50c -0.02
     26000.55c -0.68
     28000.50c -0.10
c Water (H, O)
m63   1001.50c 0.666667
      8016.50c 0.333333
c Air (C, N, O, Ar) composition from Attix p. 523
m64   6000.50c -0.000124
      7014.50c -0.755267
      8016.50c -0.231781
     18000.35d -0.012828
c Carbon steel (C, Fe)
m65   6000.50c -0.005
     26000.55c -0.995
c Pu(NO3)4 Solution
m66   1001.50c 6.19542E-02
      7014.50c 2.01476E-03
      8016.50c 3.70214E-02
     94238.50c 2.17560E-06
     94239.55c 4.84386E-04
     94241.50c 1.45901E-05
     94242.50c 2.53764E-06
c Concrete (NBS Ordinary) from Harmon et. al. Criticality Calculation
c with MCNP. A Primer. p. C-5 (Elements: H, O, Na, Si, Al, Ca, Fe, K
c adjusted to sum to unity without minor trace elements)
m67   1001.50c -0.006
      8016.50c -0.5
     11023.50c -0.017
     13027.50c -0.048
     14000.50c -0.315
     19000.50c -0.019
     20000.50c -0.083
     26000.55c -0.012
c
mode n
print 40 60 80 100 110 126
kcode 400 1. 20 120
ksrc 0  0  0
```

15PIP155

```
=CSAS25   PARM=SIZE=250000
15.5IN x 36IN x 50FT BASKET FULL OF 1.5IN PIPES HALF FULL OF PUNH
15PIP155
'HUGGED BY 3 MEN  1.5 FT X 1.0 FT X 6 FT IN FRONT
'AND 3FT CONCRETE IN BACK AND BOTTOM
27GROUPNDF4  INFHOMMEDIUM
SOLNPU(NO3)4 1 200 0 1. 293 94238 0.43 94239 96.14 94241 2.92 94242
0.51 END
'SOLNUO2(NO3)2 1 350 0 1. 293 92235 5. 92238 95.  END
H2O  2 1.0 END
SS304 3 1.0 END
H2O  4 .01 END
REG-CONCRETE  5  1.0  END
END COMP
15.5IN x 36IN x 50FT BASKET FULL OF 1.5IN PIPES HALF FULL OF PUNH
15PIP155
READ PARM NB8=300 GEN=100 NPG=5300 NSK=20
TBA=4 NUB=YES TME=1000 PLT=NO END PARM
READ GEOM

  COM="1.5 IN X 1524.2  CM PIPE HALF FULL OF PLUTONIUM NITRATE"
UNIT 1
XCYLINDER   4 1 1.347  1524.   0.00 ORIGIN  2.45 2.45
XCYLINDER   1 1 1.905  1524.   0.00 ORIGIN  2.45 2.45
XCYLINDER   3 1 2.413  1524.   0.00 ORIGIN  2.45  2.45

  COM="BASKET"
UNIT 2
CUBOID   4  1   1525.  0.001 92.390  0.635  40.351 0.635
HOLE 1  0.002 0.636 0.636
HOLE 1  0.002 0.636 5.661
HOLE 1  0.002 0.636 10.577

HOLE 1 0.002 5.463 0.636
HOLE 1 0.002 5.463 5.661
HOLE 1 0.002 5.463 10.577

HOLE 1 0.002  10.29  0.636
HOLE 1 0.002  10.29  5.661
HOLE 1 0.002  10.29  10.577

HOLE 1 0.002 15.117 0.636
HOLE 1 0.002 15.117 5.661
HOLE 1 0.002 15.117  10.577

HOLE 1 0.002 19.944  0.636
HOLE 1 0.002 19.944  5.661
HOLE 1 0.002 19.944  10.577

HOLE 1 0.002 24.771  0.636
HOLE 1 0.002 24.771  5.661
HOLE 1 0.002 24.771  10.577

HOLE 1 0.002 29.598  0.636
HOLE 1 0.002 29.598  5.661
HOLE 1 0.002 29.598  10.577

HOLE 1 0.002 34.425  0.636
HOLE 1 0.002 34.425  5.661
HOLE 1 0.002 34.425  10.577


HOLE 1 0.002 39.252  0.636
HOLE 1 0.002 39.252  5.661
```

```
HOLE 1 0.002 39.252  10.577

HOLE 1 0.002 44.079  0.636
HOLE 1 0.002 44.079  5.661
HOLE 1 0.002 44.079  10.577

HOLE 1 0.002 48.906  0.636
HOLE 1 0.002 48.906  5.661
HOLE 1 0.002 48.906  10.577

HOLE 1 0.002  53.733 0.636
HOLE 1 0.002  53.733 5.661
HOLE 1 0.002  53.733 10.577

HOLE 1 0.002 58.560 0.636
HOLE 1 0.002 58.560 5.661
HOLE 1 0.002 58.560  10.577

HOLE 1 0.002 63.387  0.636
HOLE 1 0.002 63.387  5.661
HOLE 1 0.002 63.387  10.577

HOLE 1 0.002 68.214  0.636
HOLE 1 0.002 68.214  5.661
HOLE 1 0.002 68.214  10.577

HOLE 1 0.002 73.041  0.636
HOLE 1 0.002 73.041  5.661
HOLE 1 0.002 73.041  10.577

HOLE 1 0.002 77.868  0.636
HOLE 1 0.002 77.868  5.661
HOLE 1 0.002 77.868  10.577

HOLE 1 0.002 82.695  0.636
HOLE 1 0.002 82.695  5.661
HOLE 1 0.002 82.695  10.577

HOLE 1 0.002 87.522  0.636
HOLE 1 0.002 87.522  5.661
HOLE 1 0.002 87.522  10.577

COM="5.7"

HOLE 1  0.002 0.636 15.417
HOLE 1  0.002 0.636 20.442
HOLE 1  0.002 0.636 25.358

HOLE 1 0.002 5.463 15.417
HOLE 1 0.002 5.463 20.442
HOLE 1 0.002 5.463 25.358

HOLE 1 0.002  10.29  15.417
HOLE 1 0.002  10.29  20.442
HOLE 1 0.002  10.29  25.358

HOLE 1 0.002 15.117 15.417
HOLE 1 0.002 15.117 20.442
HOLE 1 0.002 15.117  25.358

HOLE 1 0.002 19.944  15.417
HOLE 1 0.002 19.944  20.442
HOLE 1 0.002 19.944  25.358

HOLE 1 0.002 24.771  15.417
HOLE 1 0.002 24.771  20.442
HOLE 1 0.002 24.771  25.358

HOLE 1 0.002 29.598  15.417
HOLE 1 0.002 29.598  20.442
HOLE 1 0.002 29.598  25.358

HOLE 1 0.002 34.425  15.417
HOLE 1 0.002 34.425  20.442
HOLE 1 0.002 34.425  25.358

HOLE 1 0.002 39.252  15.417
HOLE 1 0.002 39.252  20.442
HOLE 1 0.002 39.252  25.358

HOLE 1 0.002 44.079  15.417
HOLE 1 0.002 44.079  20.442
HOLE 1 0.002 44.079  25.358

HOLE 1 0.002 48.906  15.417
HOLE 1 0.002 48.906  20.442
HOLE 1 0.002 48.906  25.358

HOLE 1 0.002  53.733 15.417
HOLE 1 0.002  53.733 20.442
HOLE 1 0.002  53.733 25.358

HOLE 1 0.002 58.560 15.417
HOLE 1 0.002 58.560 20.442
HOLE 1 0.002 58.560  25.358

HOLE 1 0.002 63.387  15.417
HOLE 1 0.002 63.387  20.442
HOLE 1 0.002 63.387  25.358

HOLE 1 0.002 68.214  15.417

  COM="SLAB OF CONCRETE 3FT X 3FT X 50FT"
UNIT 4
CUBOID   5  1  1524.001 0.  92.076 0.  91.44  0.
```

```
HOLE 1 0.002 68.214  20.442
HOLE 1 0.002 68.214  25.358

HOLE 1 0.002 73.041  15.417
HOLE 1 0.002 73.041  20.442
HOLE 1 0.002 73.041  25.358

HOLE 1 0.002 77.868  15.417
HOLE 1 0.002 77.868  20.442
HOLE 1 0.002 77.868  25.358

HOLE 1 0.002 82.695  15.417
HOLE 1 0.002 82.695  20.442
HOLE 1 0.002 82.695  25.358

HOLE 1 0.002 87.522  15.417
HOLE 1 0.002 87.522  20.442
HOLE 1 0.002 87.522  25.358

COM="11.4"

HOLE 1  0.002 0.636 30.198
HOLE 1  0.002 0.636 35.423
'HOLE 1  0.002 0.636 20.431

HOLE 1 0.002 5.463 30.198
HOLE 1 0.002 5.463 35.423
'HOLE 1 0.002 5.463 20.431

HOLE 1 0.002  10.29  30.198
HOLE 1 0.002  10.29  35.423
'HOLE 1 0.002  10.29  20.431

HOLE 1 0.002 15.117 30.198
HOLE 1 0.002 15.117 35.423
'HOLE 1 0.002 15.117  20.431

HOLE 1 0.002 19.944  30.198
HOLE 1 0.002 19.944  35.423
'HOLE 1 0.002 19.944  20.431

HOLE 1 0.002 24.771  30.198
HOLE 1 0.002 24.771  35.423
'HOLE 1 0.002 24.771  20.431

HOLE 1 0.002 29.598  30.198
HOLE 1 0.002 29.598  35.423
'HOLE 1 0.002 29.598  20.431

HOLE 1 0.002 34.425  30.198
HOLE 1 0.002 34.425  35.423
'HOLE 1 0.002 34.425  20.431

HOLE 1 0.002 39.252  30.198
HOLE 1 0.002 39.252  35.423
'HOLE 1 0.002 39.252  20.431

HOLE 1 0.002 44.079  30.198
HOLE 1 0.002 44.079  35.423
'HOLE 1 0.002 44.079  20.431

HOLE 1 0.002 48.906  30.198
HOLE 1 0.002 48.906  35.423
'HOLE 1 0.002 48.906  20.431

HOLE 1 0.002  53.733 30.198
HOLE 1 0.002  53.733 35.423
'HOLE 1 0.002  53.733 20.431

HOLE 1 0.002 58.560 30.198
HOLE 1 0.002 58.560 35.423
'HOLE 1 0.002 58.560  20.431

HOLE 1 0.002 63.387  30.198
HOLE 1 0.002 63.387  35.423
'HOLE 1 0.002 63.387  20.431

HOLE 1 0.002 68.214  30.198
HOLE 1 0.002 68.214  35.423
'HOLE 1 0.002 68.214  20.431

HOLE 1 0.002 73.041  30.198
HOLE 1 0.002 73.041  35.423
'HOLE 1 0.002 73.041  20.431

HOLE 1 0.002 77.868  30.198
HOLE 1 0.002 77.868  35.423
'HOLE 1 0.002 77.868  20.431

HOLE 1 0.002 82.695  30.198
HOLE 1 0.002 82.695  35.423
'HOLE 1 0.002 82.695  20.431

HOLE 1 0.002 87.522  30.198
HOLE 1 0.002 87.522  35.423
'HOLE 1 0.002 87.522  20.431

CUBOID   4  1   1525.001 0.  92.391 0.  40.986   0.

  COM="MAN 12IN X 18IN X6FT - 540LB"
UNIT 3
CUBOID   2  1 45.72  0. 182.88  0.   30.48  0.
```

```
  COM="SLAB OF CONCRETE 3FT X 4.5FT X 50FT"
UNIT 5
CUBOID   5  1  1524.001 0. 0. -91.44   45.72  -91.44

UNIT 10
SPHERE 2 1 1.6 ORIGIN 0. 0. 0.

GLOBAL
UNIT 6
CUBOID   4  1 1525.002 -0.001  297.04  -91.45   90.0  -91.45
HOLE   2   0. 0. 0.
HOLE   3   685. 0.  40.990
HOLE   3   740. 0. 40.990
HOLE   3   795. 0. 40.990
HOLE   4   0. 0. -91.44
HOLE   5   0.  0.     0.001
'HOLE 10 764.45 3.086  3.086
'HOLE 10 764.45 3.086  8.111
'HOLE 10 761.45 44.45  23.45

END GEOM
READ START NST=6
TFX=764.45 TFY=3.086 TFZ=3.086 LNU=100
TFX=764.45 TFY=3.086 TFZ=8.111 LNU=200
TFX=764.45 TFY=3.086 TFZ=13.027 LNU=300
TFX=764.45 TFY=7.277 TFZ=5.697 LNU=400
TFX=764.45 TFY=7.277 TFZ=10.597 LNU=500
TFX=764.45 TFY=11.468 TFZ=3.086 LNU=600
TFX=764.45 TFY=11.468 TFZ=8.111 LNU=700
TFX=764.45 TFY=11.468 TFZ=13.027 LNU=800
TFX=764.45 TFY=15.659 TFZ=5.697 LNU=900
TFX=764.45 TFY=15.659 TFZ=10.597 LNU=1000
TFX=764.45 TFY=19.850 TFZ=3.086 LNU=1100
TFX=764.45 TFY=19.850 TFZ=8.111 LNU=1200
TFX=764.45 TFY=19.850 TFZ=13.027 LNU=1300
TFX=764.45 TFY=24.041 TFZ=5.697 LNU=1400
TFX=764.45 TFY=24.041 TFZ=10.597 LNU=1500
TFX=764.45 TFY=28.232 TFZ=3.086 LNU=1600
TFX=764.45 TFY=28.232 TFZ=8.111 LNU=1700
TFX=764.45 TFY=28.232 TFZ=13.027 LNU=1800
TFX=764.45 TFY=32.423 TFZ=5.697 LNU=1900
TFX=764.45 TFY=32.423 TFZ=10.597 LNU=2000
TFX=764.45 TFY=36.614 TFZ=3.086 LNU=2100
TFX=764.45 TFY=36.614 TFZ=8.111 LNU=2200
TFX=764.45 TFY=36.614 TFZ=13.027 LNU=2300
TFX=764.45 TFY=40.805 TFZ=5.697 LNU=2400
TFX=764.45 TFY=40.805 TFZ=10.597 LNU=2500
TFX=764.45 TFY=44.996 TFZ=3.086 LNU=2600
TFX=764.45 TFY=44.996 TFZ=8.111 LNU=2700
TFX=764.45 TFY=44.996 TFZ=13.027 LNU=2800
TFX=764.45 TFY=49.187 TFZ=5.697 LNU=2900
TFX=764.45 TFY=49.187 TFZ=10.597 LNU=3000
TFX=764.45 TFY=53.378 TFZ=3.086 LNU=3100
TFX=764.45 TFY=53.378 TFZ=8.111 LNU=3200
TFX=764.45 TFY=53.378 TFZ=13.027 LNU=3300
TFX=764.45 TFY=57.569 TFZ=5.697 LNU=3400
TFX=764.45 TFY=57.569 TFZ=10.597 LNU=3500
TFX=764.45 TFY=61.760 TFZ=3.086 LNU=3600
TFX=764.45 TFY=61.760 TFZ=8.111 LNU=3700
TFX=764.45 TFY=61.760 TFZ=13.027 LNU=3800
TFX=764.45 TFY=65.951 TFZ=5.697 LNU=3900
TFX=764.45 TFY=65.951 TFZ=10.597 LNU=4000
TFX=764.45 TFY=70.142 TFZ=3.086 LNU=4100
TFX=764.45 TFY=70.142 TFZ=8.111 LNU=4200
TFX=764.45 TFY=70.142 TFZ=13.027 LNU=4300
TFX=764.45 TFY=74.333 TFZ=5.697 LNU=4400
TFX=764.45 TFY=74.333 TFZ=10.597 LNU=4500
TFX=764.45 TFY=78.524 TFZ=3.086 LNU=4600
TFX=764.45 TFY=78.524 TFZ=8.111 LNU=4700
TFX=764.45 TFY=78.524 TFZ=13.027 LNU=4800
TFX=764.45 TFY=82.715 TFZ=5.697 LNU=4900
TFX=764.45 TFY=82.715 TFZ=10.597 LNU=5000
TFX=764.45 TFY=86.906 TFZ=3.086 LNU=5100
TFX=764.45 TFY=86.906 TFZ=8.111 LNU=5200
TFX=764.45 TFY=86.906 TFZ=13.027 LNU=5300
END START
END DATA
END
```

15PIP155G

```
=CSAS25   PARM=SIZE=250000
15.5IN x 36IN x 16FT BASKET FULL OF 1.5IN PIPES HALF FULL OF PUNH
15PIP155G
'HUGGED BY 3 MEN  1.5 FT X 1.0 FT X 6 FT IN FRONT
'AND 3FT CONCRETE IN BACK AND BOTTOM
'AND 32 1.5IN SCH 80 X 40FT PIPE 6IN APART 2FT ABOVE FULL OF PUNH
100GPU/L
27GROUPNDF4  INFHOMMEDIUM
SOLNPU(NO3)4 1 200 0 1. 293 94238 0.43 94239 96.14 94241 2.92 94242
0.51 END
'SOLNUO2(NO3)2 1 350 0 1. 293 92235 5. 92238 95.  END
H2O  2 1.0 END
SS304 3 1.0 END
H2O  4 .01 END
REG-CONCRETE  5  1.0  END
END COMP
15.5IN x 36IN x 16FT BASKET FULL OF 1.5IN PIPES HALF FULL OF PUNH
15PIP155G
READ PARM NB8=300 GEN=100 NPG=850 NSK=20
TBA=4 NUB=YES TME=1000 PLT=NO END PARM
READ GEOM

  COM="1.5 IN X 487.68  CM PIPE HALF FULL OF PLUTONIUM NITRATE"
UNIT 1
XCYLINDER   4 1 1.347  487.68  0.00 ORIGIN  2.45 2.45
XCYLINDER   1 1 1.905  487.68  0.00 ORIGIN  2.45 2.45
XCYLINDER   3 1 2.413  487.68  0.00 ORIGIN  2.45  2.45

  COM="BASKET"
UNIT 2
CUBOID   4  1   488.  0.001 92.390  0.635  40.351 0.635
HOLE 1  0.002 0.636 0.636
HOLE 1  0.002 0.636 5.661
HOLE 1  0.002 0.636 10.577

HOLE 1 0.002 5.463 0.636
HOLE 1 0.002 5.463 5.661
HOLE 1 0.002 5.463 10.577

HOLE 1 0.002  10.29  0.636
HOLE 1 0.002  10.29  5.661
HOLE 1 0.002  10.29  10.577

HOLE 1 0.002 15.117 0.636
HOLE 1 0.002 15.117 5.661
HOLE 1 0.002 15.117  10.577

HOLE 1 0.002 19.944  0.636
HOLE 1 0.002 19.944  5.661
HOLE 1 0.002 19.944  10.577

HOLE 1 0.002 24.771  0.636
HOLE 1 0.002 24.771  5.661
HOLE 1 0.002 24.771  10.577

HOLE 1 0.002 29.598  0.636
HOLE 1 0.002 29.598  5.661
HOLE 1 0.002 29.598  10.577

HOLE 1 0.002 34.425  0.636
HOLE 1 0.002 34.425  5.661
HOLE 1 0.002 34.425  10.577

HOLE 1 0.002 39.252  0.636
HOLE 1 0.002 39.252  5.661
HOLE 1 0.002 39.252  10.577

HOLE 1 0.002 44.079  0.636
HOLE 1 0.002 44.079  5.661
HOLE 1 0.002 44.079  10.577

HOLE 1 0.002 48.906  0.636
HOLE 1 0.002 48.906  5.661
HOLE 1 0.002 48.906  10.577

HOLE 1 0.002  53.733 0.636
HOLE 1 0.002  53.733 5.661
HOLE 1 0.002  53.733 10.577

HOLE 1 0.002 58.560 0.636
HOLE 1 0.002 58.560 5.661
HOLE 1 0.002 58.560  10.577

HOLE 1 0.002 63.387  0.636
HOLE 1 0.002 63.387  5.661
HOLE 1 0.002 63.387  10.577

HOLE 1 0.002 68.214  0.636
HOLE 1 0.002 68.214  5.661
HOLE 1 0.002 68.214  10.577

HOLE 1 0.002 73.041  0.636
HOLE 1 0.002 73.041  5.661
HOLE 1 0.002 73.041  10.577

HOLE 1 0.002 77.868  0.636
HOLE 1 0.002 77.868  5.661
HOLE 1 0.002 77.868  10.577

HOLE 1 0.002 82.695  0.636
HOLE 1 0.002 82.695  5.661
HOLE 1 0.002 82.695  10.577

HOLE 1 0.002 87.522  0.636
HOLE 1 0.002 87.522  5.661
HOLE 1 0.002 87.522  10.577

COM="5.7"

HOLE 1  0.002 0.636 15.417
HOLE 1  0.002 0.636 20.442
HOLE 1  0.002 0.636 25.358

HOLE 1 0.002 5.463 15.417
HOLE 1 0.002 5.463 20.442
HOLE 1 0.002 5.463 25.358

HOLE 1 0.002  10.29  15.417
HOLE 1 0.002  10.29  20.442

HOLE 1 0.002  10.29  25.358
```

```
HOLE 1 0.002 15.117 15.417
HOLE 1 0.002 15.117 20.442
HOLE 1 0.002 15.117  25.358

HOLE 1 0.002 19.944  15.417
HOLE 1 0.002 19.944  20.442
HOLE 1 0.002 19.944  25.358

HOLE 1 0.002 24.771  15.417
HOLE 1 0.002 24.771  20.442
HOLE 1 0.002 24.771  25.358

HOLE 1 0.002 29.598  15.417
HOLE 1 0.002 29.598  20.442
HOLE 1 0.002 29.598  25.358

HOLE 1 0.002 34.425  15.417
HOLE 1 0.002 34.425  20.442
HOLE 1 0.002 34.425  25.358

HOLE 1 0.002 39.252  15.417
HOLE 1 0.002 39.252  20.442
HOLE 1 0.002 39.252  25.358

HOLE 1 0.002 44.079  15.417
HOLE 1 0.002 44.079  20.442
HOLE 1 0.002 44.079  25.358

HOLE 1 0.002 48.906  15.417
HOLE 1 0.002 48.906  20.442
HOLE 1 0.002 48.906  25.358

HOLE 1 0.002  53.733 15.417
HOLE 1 0.002  53.733 20.442
HOLE 1 0.002  53.733 25.358

HOLE 1 0.002 58.560 15.417
HOLE 1 0.002 58.560 20.442
HOLE 1 0.002 58.560  25.358

HOLE 1 0.002 63.387  15.417
HOLE 1 0.002 63.387  20.442
HOLE 1 0.002 63.387  25.358

HOLE 1 0.002 68.214  15.417
HOLE 1 0.002 68.214  20.442
HOLE 1 0.002 68.214  25.358

HOLE 1 0.002 73.041  15.417
HOLE 1 0.002 73.041  20.442
HOLE 1 0.002 73.041  25.358

HOLE 1 0.002 77.868  15.417
HOLE 1 0.002 77.868  20.442
HOLE 1 0.002 77.868  25.358

HOLE 1 0.002 82.695  15.417
HOLE 1 0.002 82.695  20.442
HOLE 1 0.002 82.695  25.358

HOLE 1 0.002 87.522  15.417
HOLE 1 0.002 87.522  20.442
HOLE 1 0.002 87.522  25.358

COM="11.4"

HOLE 1  0.002 0.636 30.198
HOLE 1  0.002 0.636 35.423
'HOLE 1  0.002 0.636 20.431

HOLE 1 0.002 5.463 30.198
HOLE 1 0.002 5.463 35.423
'HOLE 1 0.002 5.463 20.431

HOLE 1 0.002  10.29  30.198
HOLE 1 0.002  10.29  35.423
'HOLE 1 0.002  10.29  20.431

HOLE 1 0.002 15.117 30.198
HOLE 1 0.002 15.117 35.423
'HOLE 1 0.002 15.117  20.431

HOLE 1 0.002 19.944  30.198
HOLE 1 0.002 19.944  35.423
'HOLE 1 0.002 19.944  20.431

HOLE 1 0.002 24.771  30.198
HOLE 1 0.002 24.771  35.423
'HOLE 1 0.002 24.771  20.431

HOLE 1 0.002 29.598  30.198
HOLE 1 0.002 29.598  35.423
'HOLE 1 0.002 29.598  20.431

HOLE 1 0.002 34.425  30.198
HOLE 1 0.002 34.425  35.423
'HOLE 1 0.002 34.425  20.431

HOLE 1 0.002 39.252  30.198
HOLE 1 0.002 39.252  35.423
'HOLE 1 0.002 39.252  20.431

HOLE 1 0.002 44.079  30.198
HOLE 1 0.002 44.079  35.423
'HOLE 1 0.002 44.079  20.431

HOLE 1 0.002 48.906  30.198
HOLE 1 0.002 48.906  35.423
'HOLE 1 0.002 48.906  20.431

HOLE 1 0.002  53.733 30.198
HOLE 1 0.002  53.733 35.423
'HOLE 1 0.002  53.733 20.431

HOLE 1 0.002 58.560 30.198
HOLE 1 0.002 58.560 35.423
'HOLE 1 0.002 58.560  20.431

HOLE 1 0.002 63.387  30.198
HOLE 1 0.002 63.387  35.423
'HOLE 1 0.002 63.387  20.431

HOLE 1 0.002 68.214  30.198
HOLE 1 0.002 68.214  35.423
'HOLE 1 0.002 68.214  20.431

HOLE 1 0.002 73.041  30.198
HOLE 1 0.002 73.041  35.423
'HOLE 1 0.002 73.041  20.431

HOLE 1 0.002 77.868  30.198
HOLE 1 0.002 77.868  35.423
'HOLE 1 0.002 77.868  20.431

HOLE 1 0.002 82.695  30.198
HOLE 1 0.002 82.695  35.423
'HOLE 1 0.002 82.695  20.431

HOLE 1 0.002 87.522  30.198
HOLE 1 0.002 87.522  35.423
'HOLE 1 0.002 87.522  20.431

CUBOID   4  1   488.001 0.  92.391 0.  40.986   0.

  COM="MAN 12IN X 18IN X6FT - 540LB"
UNIT 3
CUBOID   2  1 45.72  0. 182.88  0.   30.48  0.

  COM="SLAB OF CONCRETE 3FT X 3FT X 50FT"
UNIT 4
CUBOID   5  1  488.001 0.  92.076 0.  91.44  0.

  COM="SLAB OF CONCRETE 3FT X 4.5FT X 50FT"
UNIT 5
CUBOID   5  1  488.001 0. 0. -91.44   45.72  -91.44

'  COM=" 10.7532 CM DIA SPHERE OF PU-239(96)NH INSIDE DRUM"
'UNIT 6
'SPHERE   1  1 5.3766 ORIGIN 0.  0.  0.

'COM=" 22.1 IN. DIA. X 34 IN. HIGH 55 GAL DRUM FILLED WITH 125 GM
PU-239"
'DRUM IS ACTUALLY 22 X 33'
'UNIT 7
'YCYLINDER   4 1 28.067   81.  0.
'HOLE 6  -39. 45.  -66.5
'CUBOID  2  1     34.135   -39.001 162. 0.  36.135   -30.0

  COM="1.5 IN SCH 80 X 1219.2  CM PIPE FULL OF PLUTONIUM NITRATE"
UNIT 8
YCYLINDER   1 1 1.905  1219.2  0.00 ORIGIN  0.   0.
YCYLINDER   3 1 2.413  1219.2  0.00 ORIGIN  0.   0.

UNIT 10
SPHERE 2 1 1.6 ORIGIN 0. 0. 0.

GLOBAL
UNIT 9
CUBOID   4  1 530.002  -41.0   1403.0  -91.45  110.0  -91.45
HOLE   2   0. 0. 0.
HOLE   3   176.5 0.  40.990
HOLE   3   222.5 0. 40.990
HOLE   3   268.5 0. 40.990
HOLE   4   0. 0. -91.44
HOLE   5   0.  0.     0.001
'HOLE   6   351.2 45. 46.45
'HOLE   6   407.2 45. 46.45
'HOLE   6   463.2 45. 46.45
'HOLE   6   519.2 45. 46.45
'HOLE   6   -27.0 45. 46.45
'HOLE   6    29.0 45. 46.45
'HOLE   6    85.0 45. 46.45
'HOLE   6   141.0 45. 46.45
HOLE   8   0.    152.4  19.
HOLE   8   15.24    152.4  19.
HOLE   8   30.48 152.4  19.
HOLE   8   45.72    152.4  19.
HOLE   8   60.96 152.4  19.
HOLE   8   76.20    152.4  19.
HOLE   8   91.44 152.4  19.
HOLE   8  106.68    152.4  19.
HOLE   8  121.92 152.4  19.
HOLE   8  137.16    152.4  19.
HOLE   8  152.40 152.4  19.
HOLE   8  167.64    152.4  19.

HOLE   8  182.88 152.4  19.
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HOLE   8  198.12    152.4  19.
HOLE   8  213.36 152.4  19.
HOLE   8  228.60    152.4  19.
HOLE   8  243.84 152.4  19.
HOLE   8  259.08    152.4  19.
HOLE   8  274.32 152.4  19.
HOLE   8  289.56    152.4  19.
HOLE   8  304.80 152.4  19.
HOLE   8  320.04    152.4  19.
HOLE   8  335.28 152.4  19.
HOLE   8  350.52    152.4  19.
HOLE   8  365.76 152.4  19.
HOLE   8  381.00    152.4  19.
HOLE   8  396.24 152.4  19.
HOLE   8  411.48    152.4  19.
HOLE   8  426.72 152.4  19.
HOLE   8  441.96    152.4  19.
HOLE   8  457.20 152.4  19.
HOLE   8  472.44    152.4  19.

'HOLE 10 141. 45.  46.45
'HOLE 10 764.45 3.086  8.111
'HOLE 10 761.45 45.  49.
'HOLE 10 0. 0. 0.
'HOLE  10   0.    762.0  19.
END GEOM
READ START NST=6
TFX=244. TFY=3.086 TFZ=3.086 LNU=10
TFX=244. TFY=3.086 TFZ=8.111 LNU=20
TFX=244. TFY=3.086 TFZ=13.027 LNU=30
TFX=244. TFY=7.277 TFZ=5.697 LNU=40
TFX=244. TFY=7.277 TFZ=10.597 LNU=50
TFX=244. TFY=11.468 TFZ=3.086 LNU=60
TFX=244. TFY=11.468 TFZ=8.111 LNU=70
TFX=244. TFY=11.468 TFZ=13.027 LNU=80
TFX=244. TFY=15.659 TFZ=5.697 LNU=90
TFX=244. TFY=15.659 TFZ=10.597 LNU=100
TFX=244. TFY=19.850 TFZ=3.086 LNU=110
TFX=244. TFY=19.850 TFZ=8.111 LNU=120
TFX=244. TFY=19.850 TFZ=13.027 LNU=130
TFX=244. TFY=24.041 TFZ=5.697 LNU=140
TFX=244. TFY=24.041 TFZ=10.597 LNU=150
TFX=244. TFY=28.232 TFZ=3.086 LNU=160
TFX=244. TFY=28.232 TFZ=8.111 LNU=170
TFX=244. TFY=28.232 TFZ=13.027 LNU=180
TFX=244. TFY=32.423 TFZ=5.697 LNU=190
TFX=244. TFY=32.423 TFZ=10.597 LNU=200
TFX=244. TFY=36.614 TFZ=3.086 LNU=210
TFX=244. TFY=36.614 TFZ=8.111 LNU=220
TFX=244. TFY=36.614 TFZ=13.027 LNU=230
TFX=244. TFY=40.805 TFZ=5.697 LNU=240
TFX=244. TFY=40.805 TFZ=10.597 LNU=250
TFX=244. TFY=44.996 TFZ=3.086 LNU=260
TFX=244. TFY=44.996 TFZ=8.111 LNU=270
TFX=244. TFY=44.996 TFZ=13.027 LNU=280
TFX=244. TFY=49.187 TFZ=5.697 LNU=290
TFX=244. TFY=49.187 TFZ=10.597 LNU=300
TFX=244. TFY=53.378 TFZ=3.086 LNU=310
TFX=244. TFY=53.378 TFZ=8.111 LNU=320
TFX=244. TFY=53.378 TFZ=13.027 LNU=330
TFX=244. TFY=57.569 TFZ=5.697 LNU=340
TFX=244. TFY=57.569 TFZ=10.597 LNU=350
TFX=244. TFY=61.760 TFZ=3.086 LNU=360
TFX=244. TFY=61.760 TFZ=8.111 LNU=370
TFX=244. TFY=61.760 TFZ=13.027 LNU=380
TFX=244. TFY=65.951 TFZ=5.697 LNU=390
TFX=244. TFY=65.951 TFZ=10.597 LNU=400
TFX=244. TFY=70.142 TFZ=3.086 LNU=410
TFX=244. TFY=70.142 TFZ=8.111 LNU=420
TFX=244. TFY=70.142 TFZ=13.027 LNU=430
TFX=244. TFY=74.333 TFZ=5.697 LNU=440
TFX=244. TFY=74.333 TFZ=10.597 LNU=450
TFX=244. TFY=78.524 TFZ=3.086 LNU=460
TFX=244. TFY=78.524 TFZ=8.111 LNU=470
TFX=244. TFY=78.524 TFZ=13.027 LNU=480
TFX=244. TFY=82.715 TFZ=5.697 LNU=490
TFX=244. TFY=82.715 TFZ=10.597 LNU=500
TFX=244. TFY=86.906 TFZ=3.086 LNU=510
TFX=244. TFY=86.906 TFZ=8.111 LNU=520
TFX=244. TFY=86.906 TFZ=13.027 LNU=530
'TFX=-27. TFY=45. TFZ=47. LNU=540
'TFX=29. TFY=45. TFZ=47. LNU=550
'TFX=85. TFY=45. TFZ=47. LNU=560
'TFX=141. TFY=45. TFZ=47. LNU=570
'TFX=351.2 TFY=45. TFZ=47. LNU=580
'TFX=407.2 TFY=45. TFZ=47. LNU=590
'TFX=463.2 TFY=45. TFZ=47. LNU=600
'TFX=519.2 TFY=45. TFZ=47. LNU=610
TFX=0.    TFY=762.0  TFZ=19. LNU=540
TFX=15.24    TFY=762.0  TFZ=19. LNU=550
TFX=30.48 TFY=762.0  TFZ=19.    LNU=560
TFX=45.72    TFY=762.0  TFZ=19. LNU=570
TFX=60.96 TFY=762.0  TFZ=19.    LNU=580
TFX=76.20    TFY=762.0  TFZ=19. LNU=590
TFX=91.44 TFY=762.0  TFZ=19.    LNU=600
TFX=106.68    TFY=762.0  TFZ=19. LNU=610
TFX=121.92 TFY=762.0  TFZ=19.    LNU=620
TFX=137.16    TFY=762.0  TFZ=19. LNU=630
TFX=152.40 TFY=762.0  TFZ=19.    LNU=640
TFX=167.64    TFY=762.0  TFZ=19. LNU=650
TFX=182.88 TFY=762.0  TFZ=19.    LNU=660
TFX=198.12    TFY=762.0  TFZ=19. LNU=670
TFX=213.36 TFY=762.0  TFZ=19.    LNU=680
TFX=228.60    TFY=762.0  TFZ=19. LNU=690
TFX=243.84 TFY=762.0  TFZ=19.    LNU=700
TFX=259.08    TFY=762.0  TFZ=19. LNU=710
TFX=274.32 TFY=762.0  TFZ=19.    LNU=720
TFX=289.56    TFY=762.0  TFZ=19. LNU=730
TFX=304.80 TFY=762.0  TFZ=19.    LNU=740
TFX=320.04    TFY=762.0  TFZ=19. LNU=750
TFX=335.28 TFY=762.0  TFZ=19.    LNU=760
TFX=350.52    TFY=762.0  TFZ=19. LNU=770
TFX=365.76 TFY=762.0  TFZ=19.    LNU=780
TFX=381.0    TFY=762.0  TFZ=19.  LNU=790
TFX=396.24 TFY=762.0  TFZ=19.    LNU=800
TFX=411.48    TFY=762.0  TFZ=19. LNU=810
TFX=426.72 TFY=762.0  TFZ=19.    LNU=820
TFX=441.96    TFY=762.0  TFZ=19. LNU=830
TFX=457.20 TFY=762.0  TFZ=19.    LNU=840
TFX=472.44    TFY=762.0  TFZ=19. LNU=850

END START
END DATA
END
```

15PIP155E

```
=CSAS25   PARM=SIZE=250000
15.5IN x 36IN x 16FT BASKET FULL OF 1.5IN PIPES HALF FULL OF PUNH
15PIP155E
'HUGGED BY 3 MEN  1.5 FT X 1.0 FT X 6 FT IN FRONT
'AND 3FT CONCRETE IN BACK AND BOTTOM
'AND 8 55GAL DRUMS WITH SPHERE OF PUNH 200GPU/L OF 125G PU-239 EA
27GROUPNDF4  INFHOMMEDIUM
SOLNPU(NO3)4 1 200 0 1. 293 94238 0.43 94239 96.14 94241 2.92 94242
0.51 END
'SOLNUO2(NO3)2 1 350 0 1. 293 92235 5. 92238 95.  END
H2O  2 1.0 END
SS304 3 1.0 END
H2O  4 .01 END
REG-CONCRETE  5  1.0  END
END COMP
15.5IN x 36IN x 16FT BASKET FULL OF 1.5IN PIPES HALF FULL OF PUNH
15PIP155E
READ PARM NB8=300 GEN=100 NPG=6100 NSK=20
TBA=4 NUB=YES TME=1000 PLT=NO END PARM
READ GEOM

  COM="1.5 IN X 487.68  CM PIPE HALF FULL OF PLUTONIUM NITRATE"
UNIT 1
XCYLINDER   4 1 1.347  487.68  0.00 ORIGIN  2.45 2.45
XCYLINDER   1 1 1.905  487.68  0.00 ORIGIN  2.45 2.45
XCYLINDER   3 1 2.413  487.68  0.00 ORIGIN  2.45  2.45

  COM="BASKET"
UNIT 2
CUBOID   4  1   488.  0.001 92.390  0.635  40.351 0.635
HOLE 1  0.002 0.636 0.636
HOLE 1  0.002 0.636 5.661
HOLE 1  0.002 0.636 10.577

HOLE 1 0.002 5.463 0.636
HOLE 1 0.002 5.463 5.661
HOLE 1 0.002 5.463 10.577

HOLE 1 0.002  10.29  0.636
HOLE 1 0.002  10.29  5.661
HOLE 1 0.002  10.29  10.577

HOLE 1 0.002 15.117 0.636
HOLE 1 0.002 15.117 5.661
HOLE 1 0.002 15.117  10.577

HOLE 1 0.002 19.944  0.636
HOLE 1 0.002 19.944  5.661
HOLE 1 0.002 19.944  10.577

HOLE 1 0.002 24.771  0.636
HOLE 1 0.002 24.771  5.661
HOLE 1 0.002 24.771  10.577

HOLE 1 0.002 29.598  0.636
HOLE 1 0.002 29.598  5.661
HOLE 1 0.002 29.598  10.577

HOLE 1 0.002 34.425  0.636
HOLE 1 0.002 34.425  5.661
HOLE 1 0.002 34.425  10.577

HOLE 1 0.002 39.252  0.636
HOLE 1 0.002 39.252  5.661
HOLE 1 0.002 39.252  10.577

HOLE 1 0.002 44.079  0.636
HOLE 1 0.002 44.079  5.661
HOLE 1 0.002 44.079  10.577

HOLE 1 0.002 48.906  0.636
HOLE 1 0.002 48.906  5.661
HOLE 1 0.002 48.906  10.577

HOLE 1 0.002  53.733 0.636
HOLE 1 0.002  53.733 5.661

HOLE 1 0.002  53.733 10.577
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HOLE 1 0.002 58.560 0.636
HOLE 1 0.002 58.560 5.661
HOLE 1 0.002 58.560  10.577

HOLE 1 0.002 63.387  0.636
HOLE 1 0.002 63.387  5.661
HOLE 1 0.002 63.387  10.577

HOLE 1 0.002 68.214  0.636
HOLE 1 0.002 68.214  5.661
HOLE 1 0.002 68.214  10.577

HOLE 1 0.002 73.041  0.636
HOLE 1 0.002 73.041  5.661
HOLE 1 0.002 73.041  10.577

HOLE 1 0.002 77.868  0.636
HOLE 1 0.002 77.868  5.661
HOLE 1 0.002 77.868  10.577

HOLE 1 0.002 82.695  0.636
HOLE 1 0.002 82.695  5.661
HOLE 1 0.002 82.695  10.577

HOLE 1 0.002 87.522  0.636
HOLE 1 0.002 87.522  5.661
HOLE 1 0.002 87.522  10.577

COM="5.7"

HOLE 1  0.002 0.636 15.417
HOLE 1  0.002 0.636 20.442
HOLE 1  0.002 0.636 25.358

HOLE 1 0.002 5.463 15.417
HOLE 1 0.002 5.463 20.442
HOLE 1 0.002 5.463 25.358

HOLE 1 0.002  10.29  15.417
HOLE 1 0.002  10.29  20.442
HOLE 1 0.002  10.29  25.358

HOLE 1 0.002 15.117 15.417
HOLE 1 0.002 15.117 20.442
HOLE 1 0.002 15.117  25.358

HOLE 1 0.002 19.944  15.417
HOLE 1 0.002 19.944  20.442
HOLE 1 0.002 19.944  25.358

HOLE 1 0.002 24.771  15.417
HOLE 1 0.002 24.771  20.442
HOLE 1 0.002 24.771  25.358

HOLE 1 0.002 29.598  15.417
HOLE 1 0.002 29.598  20.442
HOLE 1 0.002 29.598  25.358

HOLE 1 0.002 34.425  15.417
HOLE 1 0.002 34.425  20.442
HOLE 1 0.002 34.425  25.358

HOLE 1 0.002 39.252  15.417
HOLE 1 0.002 39.252  20.442
HOLE 1 0.002 39.252  25.358

HOLE 1 0.002 44.079  15.417
HOLE 1 0.002 44.079  20.442
HOLE 1 0.002 44.079  25.358

HOLE 1 0.002 48.906  15.417
HOLE 1 0.002 48.906  20.442
HOLE 1 0.002 48.906  25.358

HOLE 1 0.002  53.733 15.417
HOLE 1 0.002  53.733 20.442
HOLE 1 0.002  53.733 25.358

HOLE 1 0.002 58.560 15.417
HOLE 1 0.002 58.560 20.442
HOLE 1 0.002 58.560  25.358

HOLE 1 0.002 63.387  15.417
HOLE 1 0.002 63.387  20.442
HOLE 1 0.002 63.387  25.358

HOLE 1 0.002 68.214  15.417
HOLE 1 0.002 68.214  20.442
HOLE 1 0.002 68.214  25.358

HOLE 1 0.002 73.041  15.417
HOLE 1 0.002 73.041  20.442
HOLE 1 0.002 73.041  25.358

HOLE 1 0.002 77.868  15.417
HOLE 1 0.002 77.868  20.442
HOLE 1 0.002 77.868  25.358

HOLE 1 0.002 82.695  15.417
HOLE 1 0.002 82.695  20.442
HOLE 1 0.002 82.695  25.358


'UNIT 7
HOLE 1 0.002 87.522  15.417
HOLE 1 0.002 87.522  20.442
HOLE 1 0.002 87.522  25.358

COM="11.4"

HOLE 1  0.002 0.636 30.198
HOLE 1  0.002 0.636 35.423
'HOLE 1  0.002 0.636 20.431

HOLE 1 0.002 5.463 30.198
HOLE 1 0.002 5.463 35.423
'HOLE 1 0.002 5.463 20.431

HOLE 1 0.002  10.29  30.198
HOLE 1 0.002  10.29  35.423
'HOLE 1 0.002  10.29  20.431

HOLE 1 0.002 15.117 30.198
HOLE 1 0.002 15.117 35.423
'HOLE 1 0.002 15.117  20.431

HOLE 1 0.002 19.944  30.198
HOLE 1 0.002 19.944  35.423
'HOLE 1 0.002 19.944  20.431

HOLE 1 0.002 24.771  30.198
HOLE 1 0.002 24.771  35.423
'HOLE 1 0.002 24.771  20.431

HOLE 1 0.002 29.598  30.198
HOLE 1 0.002 29.598  35.423
'HOLE 1 0.002 29.598  20.431

HOLE 1 0.002 34.425  30.198
HOLE 1 0.002 34.425  35.423
'HOLE 1 0.002 34.425  20.431

HOLE 1 0.002 39.252  30.198
HOLE 1 0.002 39.252  35.423
'HOLE 1 0.002 39.252  20.431

HOLE 1 0.002 44.079  30.198
HOLE 1 0.002 44.079  35.423
'HOLE 1 0.002 44.079  20.431

HOLE 1 0.002 48.906  30.198
HOLE 1 0.002 48.906  35.423
'HOLE 1 0.002 48.906  20.431

HOLE 1 0.002  53.733 30.198
HOLE 1 0.002  53.733 35.423
'HOLE 1 0.002  53.733 20.431

HOLE 1 0.002 58.560 30.198
HOLE 1 0.002 58.560 35.423
'HOLE 1 0.002 58.560  20.431

HOLE 1 0.002 63.387  30.198
HOLE 1 0.002 63.387  35.423
'HOLE 1 0.002 63.387  20.431

HOLE 1 0.002 68.214  30.198
HOLE 1 0.002 68.214  35.423
'HOLE 1 0.002 68.214  20.431

HOLE 1 0.002 73.041  30.198
HOLE 1 0.002 73.041  35.423
'HOLE 1 0.002 73.041  20.431

HOLE 1 0.002 77.868  30.198
HOLE 1 0.002 77.868  35.423
'HOLE 1 0.002 77.868  20.431

HOLE 1 0.002 82.695  30.198
HOLE 1 0.002 82.695  35.423
'HOLE 1 0.002 82.695  20.431

HOLE 1 0.002 87.522  30.198
HOLE 1 0.002 87.522  35.423
'HOLE 1 0.002 87.522  20.431

CUBOID   4  1   488.001 0.  92.391 0.  40.986   0.

  COM="MAN 12IN X 18IN X6FT - 540LB"
UNIT 3
CUBOID   2  1 45.72  0. 182.88  0.   30.48  0.

  COM="SLAB OF CONCRETE 3FT X 3FT X 50FT"
UNIT 4
CUBOID   5  1  488.001 0.  92.076 0.  91.44  0.

  COM="SLAB OF CONCRETE 3FT X 4.5FT X 50FT"
UNIT 5
CUBOID   5  1  488.001 0. 0. -91.44   45.72  -91.44

  COM=" 10.7532 CM DIA SPHERE OF PU-239(96)NH INSIDE DRUM"
UNIT 6
SPHERE   1  1 5.3766 ORIGIN 0.  0.  0.

'COM=" 22.1 IN. DIA. X 34 IN. HIGH 55 GAL DRUM FILLED WITH 125 GM
PU-239"
'DRUM IS ACTUALLY 22 X 33'
```

```
'YCYLINDER   4 1 28.067   81.  0.
'HOLE 6  -39. 45.  -66.5
'CUBOID  2  1     34.135   -39.001 162. 0.  36.135   -30.0

UNIT 10
SPHERE 2 1 1.6 ORIGIN 0. 0. 0.

GLOBAL
UNIT 8
CUBOID   4  1 530.002 -41.0   297.04  -91.45   110.0  -91.45
HOLE   2   0. 0. 0.
HOLE   3   176.5 0.  40.990
HOLE   3   222.5 0. 40.990
HOLE   3   268.5 0. 40.990
HOLE   4   0. 0. -91.44
HOLE   5   0.  0.     0.001
HOLE   6   351.2 45. 46.45
HOLE   6   407.2 45. 46.45
HOLE   6   463.2 45. 46.45
HOLE   6   519.2 45. 46.45
HOLE   6   -27.0 45. 46.45
HOLE   6    29.0 45. 46.45
HOLE   6    85.0 45. 46.45
HOLE   6   141.0 45. 46.45

'HOLE 10 141. 45.  46.45
'HOLE 10 764.45 3.086  8.111
'OLE 10 761.45 45.  49.

END GEOM
READ START NST=6
TFX=244. TFY=3.086 TFZ=3.086 LNU=100
TFX=244. TFY=3.086 TFZ=8.111 LNU=200
TFX=244. TFY=3.086 TFZ=13.027 LNU=300
TFX=244. TFY=7.277 TFZ=5.697 LNU=440
TFX=244. TFY=7.277 TFZ=10.597 LNU=500
TFX=244. TFY=11.468 TFZ=3.086 LNU=600
TFX=244. TFY=11.468 TFZ=8.111 LNU=700
TFX=244. TFY=11.468 TFZ=13.027 LNU=800
TFX=244. TFY=15.659 TFZ=5.697 LNU=900
TFX=244. TFY=15.659 TFZ=10.597 LNU=1000
TFX=244. TFY=19.850 TFZ=3.086 LNU=1100
TFX=244. TFY=19.850 TFZ=8.111 LNU=1200
TFX=244. TFY=19.850 TFZ=13.027 LNU=1300
TFX=244. TFY=24.041 TFZ=5.697 LNU=1400
TFX=244. TFY=24.041 TFZ=10.597 LNU=1500
TFX=244. TFY=28.232 TFZ=3.086 LNU=1600
TFX=244. TFY=28.232 TFZ=8.111 LNU=1700
TFX=244. TFY=28.232 TFZ=13.027 LNU=1800
TFX=244. TFY=32.423 TFZ=5.697 LNU=1900
TFX=244. TFY=32.423 TFZ=10.597 LNU=2000
TFX=244. TFY=36.614 TFZ=3.086 LNU=2100
TFX=244. TFY=36.614 TFZ=8.111 LNU=2200
TFX=244. TFY=36.614 TFZ=13.027 LNU=2300
TFX=244. TFY=40.805 TFZ=5.697 LNU=2400
TFX=244. TFY=40.805 TFZ=10.597 LNU=2500
TFX=244. TFY=44.996 TFZ=3.086 LNU=2600
TFX=244. TFY=44.996 TFZ=8.111 LNU=2700
TFX=244. TFY=44.996 TFZ=13.027 LNU=2800
TFX=244. TFY=49.187 TFZ=5.697 LNU=2900
TFX=244. TFY=49.187 TFZ=10.597 LNU=3000
TFX=244. TFY=53.378 TFZ=3.086 LNU=3100
TFX=244. TFY=53.378 TFZ=8.111 LNU=3200
TFX=244. TFY=53.378 TFZ=13.027 LNU=3300
TFX=244. TFY=57.569 TFZ=5.697 LNU=3400
TFX=244. TFY=57.569 TFZ=10.597 LNU=3500
TFX=244. TFY=61.760 TFZ=3.086 LNU=3600
TFX=244. TFY=61.760 TFZ=8.111 LNU=3700
TFX=244. TFY=61.760 TFZ=13.027 LNU=3800
TFX=244. TFY=65.951 TFZ=5.697 LNU=3900
TFX=244. TFY=65.951 TFZ=10.597 LNU=4000
TFX=244. TFY=70.142 TFZ=3.086 LNU=4100
TFX=244. TFY=70.142 TFZ=8.111 LNU=4200
TFX=244. TFY=70.142 TFZ=13.027 LNU=4300
TFX=244. TFY=74.333 TFZ=5.697 LNU=4400
TFX=244. TFY=74.333 TFZ=10.597 LNU=4500
TFX=244. TFY=78.524 TFZ=3.086 LNU=4600
TFX=244. TFY=78.524 TFZ=8.111 LNU=4700
TFX=244. TFY=78.524 TFZ=13.027 LNU=4800
TFX=244. TFY=82.715 TFZ=5.697 LNU=4900
TFX=244. TFY=82.715 TFZ=10.597 LNU=5000
TFX=244. TFY=86.906 TFZ=3.086 LNU=5100
TFX=244. TFY=86.906 TFZ=8.111 LNU=5200
TFX=244. TFY=86.906 TFZ=13.027 LNU=5300
TFX=-27. TFY=45. TFZ=47. LNU=5400
TFX=29. TFY=45. TFZ=47. LNU=5500
TFX=85. TFY=45. TFZ=47. LNU=5600
TFX=141. TFY=45. TFZ=47. LNU=5700
TFX=351.2 TFY=45. TFZ=47. LNU=5800
TFX=407.2 TFY=45. TFZ=47. LNU=5900
TFX=463.2 TFY=45. TFZ=47. LNU=6000
TFX=519.2 TFY=45. TFZ=47. LNU=6100
END START
END DATA
END
```

SQ24

```
=CSAS25   PARM=SIZE=250000
24IN x 24IN x 36IN BASKET FULL OF 1.5IN PIPES HALF FULL OF PUNH  SQ24
'HUGGED BY 3 MEN  1.5 FT X 1.0 FT X 6 FT IN FRONT
'AND 3FT CONCRETE IN BACK, END, AND BOTTOM
27GROUPNDF4  INFHOMMEDIUM
SOLNPU(NO3)4 1 200 0 1. 293 94238 0.43 94239 96.14 94241 2.92 94242
0.51 END
'SOLNUO2(NO3)2 1 350 0 1. 293 92235 5. 92238 95.  END
H2O  2 1.0 END
SS304 3 1.0 END
H2O  4 .01 END
REG-CONCRETE  5  1.0  END
END COMP
24IN x 24IN x 36IN BASKET FULL OF 1.5IN PIPES HALF FULL OF PUNH  SQ24
READ PARM NB8=300 GEN=100 NPG=3080 NSK=20
TBA=4 NUB=YES TME=1000 PLT=NO END PARM
READ GEOM

  COM="1.5 IN X 1524.2  CM PIPE FULL OF PLUTONIUM NITRATE"
UNIT 1
XCYLINDER   4 1 1.347  60.96   0.00 ORIGIN  2.45 2.45
XCYLINDER   1 1 1.905  60.96   0.00 ORIGIN  2.45 2.45
XCYLINDER   3 1 2.413  60.96   0.00 ORIGIN  2.45  2.45

  COM="BASKET"
UNIT 2
CUBOID   4  1   61.0  0.001 92.390  0.635  60.594 0.635
HOLE 1  0.002 0.636 0.636
HOLE 1  0.002 0.636 5.661
HOLE 1  0.002 0.636 10.577

HOLE 1 0.002 5.463 0.636
HOLE 1 0.002 5.463 5.661
HOLE 1 0.002 5.463 10.577

HOLE 1 0.002  10.29  0.636
HOLE 1 0.002  10.29  5.661
HOLE 1 0.002  10.29  10.577

HOLE 1 0.002 15.117 0.636
HOLE 1 0.002 15.117 5.661
HOLE 1 0.002 15.117  10.577

HOLE 1 0.002 19.944  0.636
HOLE 1 0.002 19.944  5.661
HOLE 1 0.002 19.944  10.577

HOLE 1 0.002 24.771  0.636
HOLE 1 0.002 24.771  5.661
HOLE 1 0.002 24.771  10.577

HOLE 1 0.002 29.598  0.636
HOLE 1 0.002 29.598  5.661
HOLE 1 0.002 29.598  10.577

HOLE 1 0.002 34.425  0.636
HOLE 1 0.002 34.425  5.661
HOLE 1 0.002 34.425  10.577

HOLE 1 0.002 39.252  0.636
HOLE 1 0.002 39.252  5.661
HOLE 1 0.002 39.252  10.577

HOLE 1 0.002 44.079  0.636
HOLE 1 0.002 44.079  5.661
HOLE 1 0.002 44.079  10.577

HOLE 1 0.002 48.906  0.636
HOLE 1 0.002 48.906  5.661
HOLE 1 0.002 48.906  10.577

HOLE 1 0.002  53.733 0.636
HOLE 1 0.002  53.733 5.661
HOLE 1 0.002  53.733 10.577

HOLE 1 0.002 58.560 0.636
HOLE 1 0.002 58.560 5.661
HOLE 1 0.002 58.560  10.577

HOLE 1 0.002 63.387  0.636
HOLE 1 0.002 63.387  5.661
HOLE 1 0.002 63.387  10.577

HOLE 1 0.002 68.214  0.636
HOLE 1 0.002 68.214  5.661
HOLE 1 0.002 68.214  10.577

HOLE 1 0.002 73.041  0.636
HOLE 1 0.002 73.041  5.661
HOLE 1 0.002 73.041  10.577

HOLE 1 0.002 77.868  0.636
HOLE 1 0.002 77.868  5.661
HOLE 1 0.002 77.868  10.577

HOLE 1 0.002 82.695  0.636
HOLE 1 0.002 82.695  5.661
HOLE 1 0.002 82.695  10.577

HOLE 1 0.002 87.522  0.636
HOLE 1 0.002 87.522  5.661
HOLE 1 0.002 87.522  10.577

COM="5.7"
HOLE 1  0.002 0.636 15.417
HOLE 1  0.002 0.636 20.442
HOLE 1  0.002 0.636 25.358
```

```
HOLE 1 0.002 5.463 15.417
HOLE 1 0.002 5.463 20.442
HOLE 1 0.002 5.463 25.358

HOLE 1 0.002  10.29  15.417
HOLE 1 0.002  10.29  20.442
HOLE 1 0.002  10.29  25.358

HOLE 1 0.002 15.117 15.417
HOLE 1 0.002 15.117 20.442
HOLE 1 0.002 15.117  25.358

HOLE 1 0.002 19.944  15.417
HOLE 1 0.002 19.944  20.442
HOLE 1 0.002 19.944  25.358

HOLE 1 0.002 24.771  15.417
HOLE 1 0.002 24.771  20.442
HOLE 1 0.002 24.771  25.358

HOLE 1 0.002 29.598  15.417
HOLE 1 0.002 29.598  20.442
HOLE 1 0.002 29.598  25.358

HOLE 1 0.002 34.425  15.417
HOLE 1 0.002 34.425  20.442
HOLE 1 0.002 34.425  25.358

HOLE 1 0.002 39.252  15.417
HOLE 1 0.002 39.252  20.442
HOLE 1 0.002 39.252  25.358

HOLE 1 0.002 44.079  15.417
HOLE 1 0.002 44.079  20.442
HOLE 1 0.002 44.079  25.358

HOLE 1 0.002 48.906  15.417
HOLE 1 0.002 48.906  20.442
HOLE 1 0.002 48.906  25.358

HOLE 1 0.002  53.733 15.417
HOLE 1 0.002  53.733 20.442
HOLE 1 0.002  53.733 25.358

HOLE 1 0.002 58.560 15.417
HOLE 1 0.002 58.560 20.442
HOLE 1 0.002 58.560  25.358

HOLE 1 0.002 63.387  15.417
HOLE 1 0.002 63.387  20.442
HOLE 1 0.002 63.387  25.358

HOLE 1 0.002 68.214  15.417
HOLE 1 0.002 68.214  20.442
HOLE 1 0.002 68.214  25.358

HOLE 1 0.002 73.041  15.417
HOLE 1 0.002 73.041  20.442
HOLE 1 0.002 73.041  25.358

HOLE 1 0.002 77.868  15.417
HOLE 1 0.002 77.868  20.442
HOLE 1 0.002 77.868  25.358

HOLE 1 0.002 82.695  15.417
HOLE 1 0.002 82.695  20.442
HOLE 1 0.002 82.695  25.358

HOLE 1 0.002 87.522  15.417
HOLE 1 0.002 87.522  20.442
HOLE 1 0.002 87.522  25.358

COM="11.4"

HOLE 1  0.002 0.636 30.198
HOLE 1  0.002 0.636 35.123
HOLE 1  0.002 0.636 40.139

HOLE 1 0.002 5.463 30.198
HOLE 1 0.002 5.463 35.123
HOLE 1 0.002 5.463 40.139

HOLE 1 0.002  10.29  30.198
HOLE 1 0.002  10.29  35.123
HOLE 1 0.002  10.29  40.139

HOLE 1 0.002 15.117 30.198
HOLE 1 0.002 15.117 35.123
HOLE 1 0.002 15.117  40.139

HOLE 1 0.002 19.944  30.198
HOLE 1 0.002 19.944  35.123
HOLE 1 0.002 19.944  40.139

HOLE 1 0.002 24.771  30.198
HOLE 1 0.002 24.771  35.123
HOLE 1 0.002 24.771  40.139

HOLE 1 0.002 29.598  30.198
HOLE 1 0.002 29.598  35.123
HOLE 1 0.002 29.598  40.139

HOLE 1 0.002 34.425  30.198
HOLE 1 0.002 34.425  35.123
HOLE 1 0.002 34.425  40.139

HOLE 1 0.002 39.252  30.198
HOLE 1 0.002 39.252  35.123
HOLE 1 0.002 39.252  40.139

HOLE 1 0.002 44.079  30.198
HOLE 1 0.002 44.079  35.123
HOLE 1 0.002 44.079  40.139

HOLE 1 0.002 48.906  30.198
HOLE 1 0.002 48.906  35.123
HOLE 1 0.002 48.906  40.139

HOLE 1 0.002  53.733 30.198
HOLE 1 0.002  53.733 35.123
HOLE 1 0.002  53.733 40.139

HOLE 1 0.002 58.560 30.198
HOLE 1 0.002 58.560 35.123
HOLE 1 0.002 58.560  40.139

HOLE 1 0.002 63.387  30.198
HOLE 1 0.002 63.387  35.123
HOLE 1 0.002 63.387  40.139

HOLE 1 0.002 68.214  30.198
HOLE 1 0.002 68.214  35.123
HOLE 1 0.002 68.214  40.139

HOLE 1 0.002 73.041  30.198
HOLE 1 0.002 73.041  35.123
HOLE 1 0.002 73.041  40.139

HOLE 1 0.002 77.868  30.198
HOLE 1 0.002 77.868  35.123
HOLE 1 0.002 77.868  40.139

HOLE 1 0.002 82.695  30.198
HOLE 1 0.002 82.695  35.123
HOLE 1 0.002 82.695  40.139

HOLE 1 0.002 87.522  30.198
HOLE 1 0.002 87.522  35.123
HOLE 1 0.002 87.522  40.139

COM="17.5"

HOLE 1  0.002 0.636 44.979
HOLE 1  0.002 0.636 49.904
HOLE 1  0.002 0.636 54.920

HOLE 1 0.002 5.463 44.979
HOLE 1 0.002 5.463 49.904
HOLE 1 0.002 5.463 54.920

HOLE 1 0.002  10.29  44.979
HOLE 1 0.002  10.29  49.904
HOLE 1 0.002  10.29  54.920

HOLE 1 0.002 15.117 44.979
HOLE 1 0.002 15.117 49.904
HOLE 1 0.002 15.117  54.920

HOLE 1 0.002 19.944  44.979
HOLE 1 0.002 19.944  49.904
HOLE 1 0.002 19.944  54.920

HOLE 1 0.002 24.771  44.979
HOLE 1 0.002 24.771  49.904
HOLE 1 0.002 24.771  54.920

HOLE 1 0.002 29.598  44.979
HOLE 1 0.002 29.598  49.904
HOLE 1 0.002 29.598  54.920

HOLE 1 0.002 34.425  44.979
HOLE 1 0.002 34.425  49.904
HOLE 1 0.002 34.425  54.920

HOLE 1 0.002 39.252  44.979
HOLE 1 0.002 39.252  49.904
HOLE 1 0.002 39.252  54.920

HOLE 1 0.002 44.079  44.979
HOLE 1 0.002 44.079  49.904
HOLE 1 0.002 44.079  54.920

HOLE 1 0.002 48.906  44.979
HOLE 1 0.002 48.906  49.904
HOLE 1 0.002 48.906  54.920

HOLE 1 0.002  53.733 44.979
HOLE 1 0.002  53.733 49.904
HOLE 1 0.002  53.733 54.920

HOLE 1 0.002 58.560 44.979
HOLE 1 0.002 58.560 49.904

HOLE 1 0.002 58.560  54.920
```

```
HOLE 1 0.002 63.387  44.979
HOLE 1 0.002 63.387  49.904
HOLE 1 0.002 63.387  54.920

HOLE 1 0.002 68.214  44.979
HOLE 1 0.002 68.214  49.904
HOLE 1 0.002 68.214  54.920

HOLE 1 0.002 73.041  44.979
HOLE 1 0.002 73.041  49.904
HOLE 1 0.002 73.041  54.920

HOLE 1 0.002 77.868  44.979
HOLE 1 0.002 77.868  49.904
HOLE 1 0.002 77.868  54.920

HOLE 1 0.002 82.695  44.979
HOLE 1 0.002 82.695  49.904
HOLE 1 0.002 82.695  54.920

HOLE 1 0.002 87.522  44.979
HOLE 1 0.002 87.522  49.904
HOLE 1 0.002 87.522  54.920
CUBOID   4  1   61.001 0.  92.391 0.  61.229   0.

  COM="MAN 12IN X 18IN X6FT - 540LB"
UNIT 3
CUBOID   2  1 45.72  0. 182.88  0.   30.48  0.

  COM="SLAB OF CONCRETE ON BOTTOM 6FT X 3FT X 5FT"
UNIT 4
CUBOID   5  1  182.88 0.  .0 -91.44   60.96  -91.44

  COM="SLAB OF CONCRETE IN REAR 6FT X 3FT X 3FT"
UNIT 5
CUBOID   5  1  182.88 0.  92.391 0.   -.001 -91.44

  COM="SLAB OF CONCRETE ON END  3FT X 6FT X 5FT"
UNIT 6
CUBOID   5  1  0.00 -91.44 91.44  -91.44   60.96  -91.44

UNIT 10
SPHERE 2 1 1.6 ORIGIN 0. 0. 0.

GLOBAL
UNIT 7
CUBOID   4  1 184.002 -91.641  200.04  -91.45   123.0  -93.00
HOLE   2   0.001 0.001 0.001
HOLE   3   0. 0.  61.232
HOLE   3   45.73 0. 61.232
HOLE   3   91.65 0. 61.232
HOLE   4   0. 0. 0.
HOLE   5   0.  0.  0.
HOLE   6   0. 0. 0.
'HOLE 10 30.48 0.636  0.636
'HOLE 10 30.48 0.636  5.661
'HOLE 10 30.48 0.636  10.577

END GEOM
READ START NST=6

TFX=30.48 TFY=3.086 TFZ=3.086  LNU=10
TFX=30.48 TFY=3.086 TFZ=8.111  LNU=20
TFX=30.48 TFY=3.086 TFZ=13.027 LNU=30

TFX=30.48 TFY=7.913 TFZ=3.086  LNU=40
TFX=30.48 TFY=7.913 TFZ=8.111  LNU=50
TFX=30.48 TFY=7.913 TFZ=13.027 LNU=60

TFX=30.48 TFY= 12.74 TFZ= 3.086 LNU=70
TFX=30.48 TFY=12.74 TFZ=8.111   LNU=80
TFX=30.48 TFY=12.74 TFZ=13.027  LNU=90

TFX=30.48 TFY=17.567 TFZ=3.086  LNU=100
TFX=30.48 TFY=17.567 TFZ=8.111  LNU=110
TFX=30.48 TFY=17.567 TFZ= 13.027 LNU=120

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END DATA
END
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WVNSCO RECORD OF REVISION

Rev. No.	Description of Changes	Revision On Page(s)	Dated
0	Original Issue	All	04/09/03